GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

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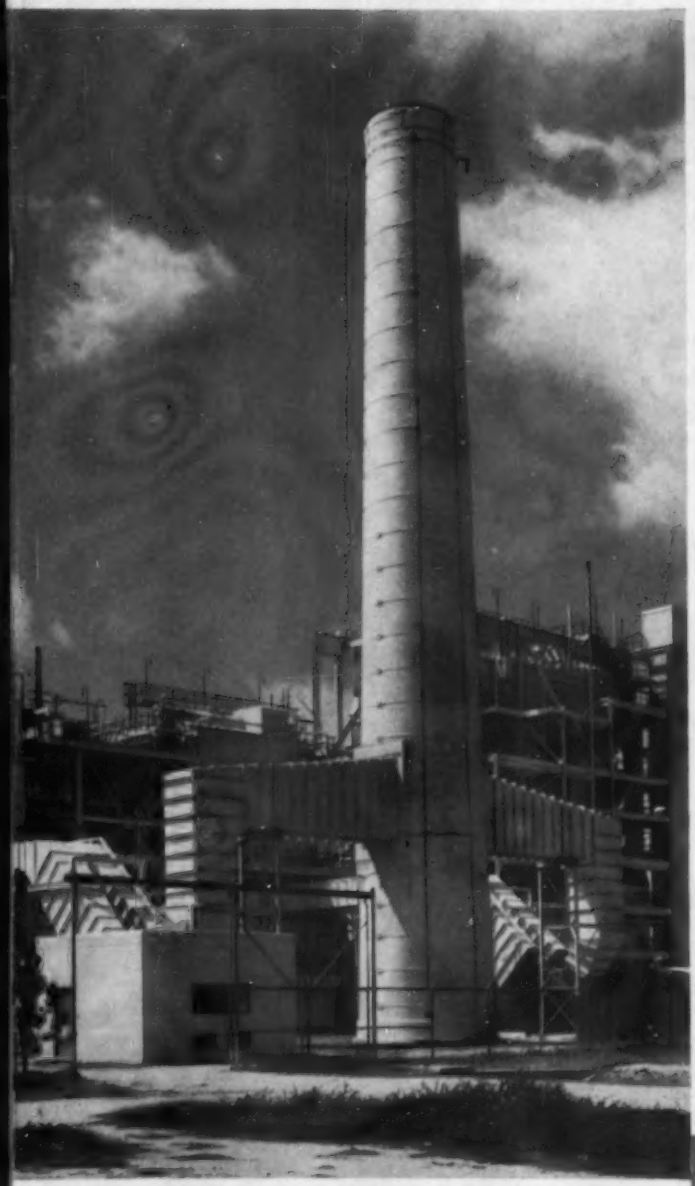
# Power

MAY
1955·50¢

A McGRAW-HILL PUBLICATION



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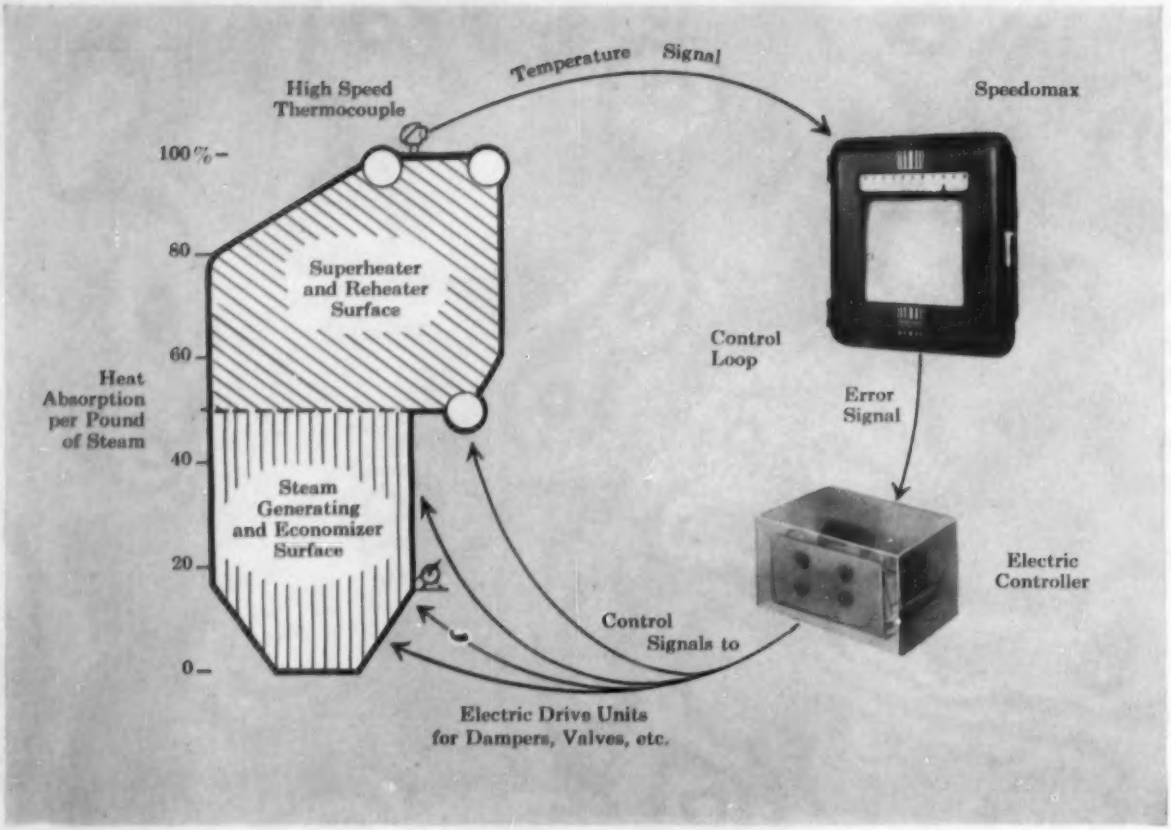



## THIS STEAM TEMPERATURE CONTROL

# puts heat where you want it!

● Because superheater and reheater surfaces of many modern boilers receive 50 per cent—or more—of the heat liberated, the proper control of heat distribution is a governing factor in attaining efficiency. Steam temperature control, by regulating this distribution, maintains optimum Btu/lb of steam, and helps prevent overheating of the metal surfaces.

L&N's *all-electric* steam temperature control solves this critical problem effectively over a wide range of load and furnace conditions. The basic components of the control are as follows:

**High Speed Thermocouples**—Especially designed to provide accurate sensing of temperature, with a response several times as fast as non-specialized thermocouples.

**Speedomax Recorders**—Provide sensitivity, accuracy and proved reliability of measurement; with auxiliary alarms and control safeguards specified for this very exacting service.

**Versatile Electric Controller**—With control actions—proportional, reset and rate—tailored to meet not only the requirements of a single operating condition (such as control of a valve), but also of *added* operating conditions (as when control must be transferred to dampers or other devices). Preliminary control action, initiated from changes in boiler air flow, is similarly tailored for each operating condition. Reheat unit control systems are coordinated to prevent one temperature control from interacting with or upsetting the other.

**Electric Drive Units**—Provide dependable, positive positioning of dampers, valves, burners, etc. under conditions both normal and adverse.

Let our engineers work with you to arrive at an effective solution of your superheat—reheat control problems. Please address us at 4910 S.enton Ave., Philadelphia 44, Pa.

**LEEDS** LN **NORTHRUP**

*instruments automatic controls • furnaces*

At U. of Maryland steam plant, coal is dumped through screens to hopper. After sizing, Link-Belt bucket elevator fills coal bin via screw conveyor on roof. Undercut chute allows reclaiming of coal from bin to truck when desired.

Link-Belt 24-in. apron conveyor feeds vibrating screen. Oversize is sent to ring crusher, from which it rejoins fine coal on belt conveyor en route to Link-Belt bucket elevator. Egli & Gompf, Inc., Baltimore, were the consulting engineers.

## How coal handling lessons learned in big power plants

# benefit a small boiler house

### LINK-BELT engineering and equipment is your assurance of lowest cost per ton handled

BACKGROUND gained in large installations has acquainted Link-Belt engineers with every kind of coal handling problem. And small plants, like the University of Maryland's, benefit from that experience and Link-Belt's complete line of equipment.

Link-Belt, working with you or your consultants, can offer you a coal handling system of *proved effectiveness* —maximum simplicity, with no improvised engineering or erection headaches. Link-Belt knows and makes what it takes to do the job right—be it feeders, crushers, unloading equipment or any kind or combination of conveyors.

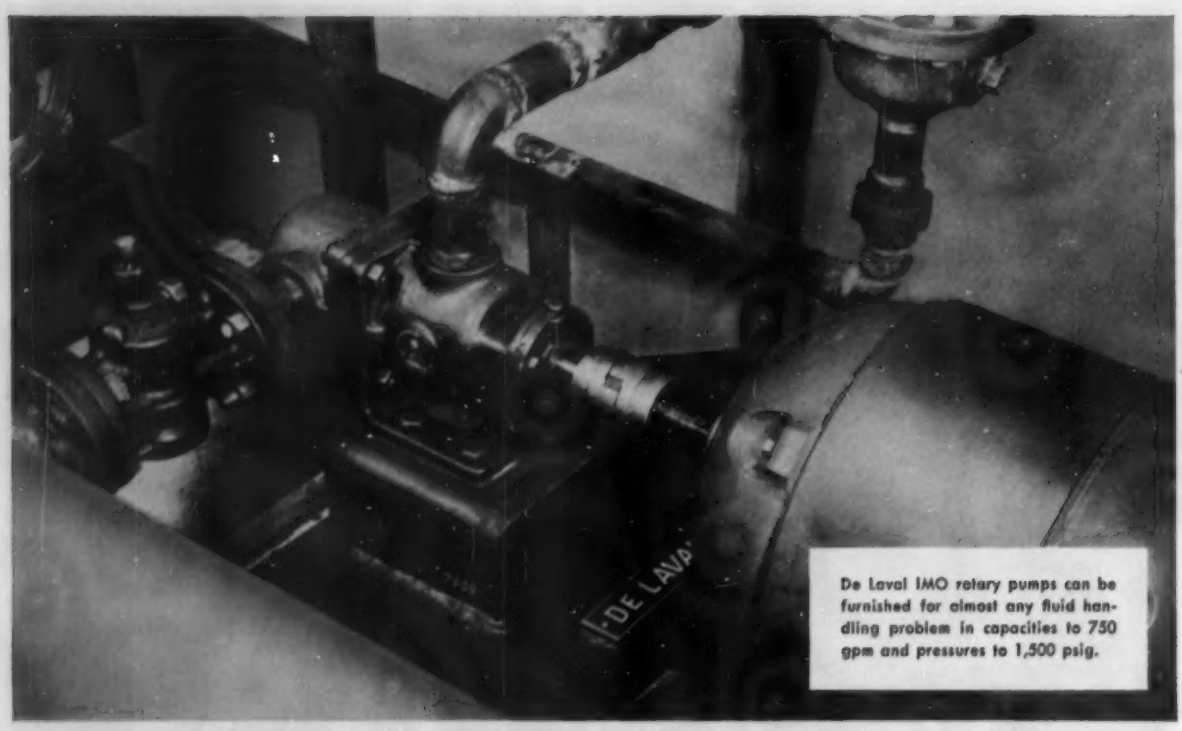
Whether your plant is large or small a Link-Belt mechanized coal handling system can save you money. Get in touch with your nearest Link-Belt office today.

*You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding coal handling systems—both large and small.*

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13:784




De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

# What to Look for in a Rotary Screw Type Pump

*By* W. J. MONCON, *Assistant Chief Engineer*
*De Laval Steam Turbine Company*

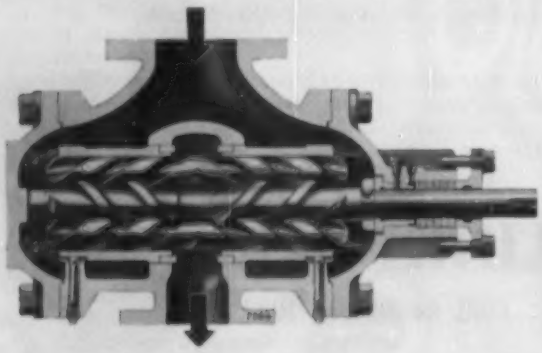
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

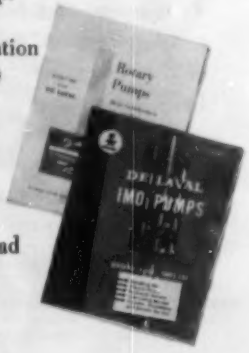
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

*Catalog LS* gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application,* contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 815 Nottingham Way, Trenton 2, New Jersey. DL-301



# Power

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**Print order this issue: 47,510**


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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

**SEMIOUTDOOR STATION,** *in left picture on this month's cover,* is the Leon Creek plant at San Antonio, Texas. Unit 1 at this plant was described in POWER, September 1950, pp 94-97. Unit 2, a duplicate of 1, started in 1951. Unit 3 is described this month, pp 71-74.

Low-investment-cost units, their design and operating details are extremely interesting. Cooling towers for condenser circulating water are proving economical for this plant, as they are in many other central stations throughout the U. S.

*In right picture,* expert advice on barrel-type feed-pump overhaul is given Associate Editor Steve Elonka by Igor Karassik (*far right*) of Worthington Corp. Two articles, pp 86-87 and 112-119, cover this important problem from the engineering and the maintenance angles. Every engineer dealing with pumps should find helpful tips in these two May articles.

### *Next month . . .*

■ MOTORS, the latest in our Special Report series, will bring you 32 pages of solid info and news of today's motors. It will include important aspects like enclosures, built-in auxiliaries, insulation, application, for ac and dc units.

After watching our Managing Editor Jim O'Connor work his way through the text and illustrations for this Report, we're sure you'll find these latest data prepared for easy reading today and quick reference tomorrow. See it in the June issue.

■ Calibrating chemical feed pumps—an important job in any plant—is the subject of a June article. Pictures and text show the actual steps to follow.

■ Automatic control of water flow and pressure for industrial, institutional and other plants can cut operating costs, reduce pump wear. See June for important know-how on these controls.

■ One way to automatically control demineralizers is another June story.

### *. . . and future months*

■ Modernization Awards for 1955 will be announced in Mid-September POWER. There's still time to submit your entry—see p 99 this month, May, for complete details. Perhaps your plant can become one of the proud winners.

# "WE ENJOY REAL FUEL ECONOMY WITH TEXACO URSA OIL"

**Elmer Leckrone, Plant Superintendent, Northwestern Public Service Company, Yankton, South Dakota**

**POWER PLANT** of Northwestern Public Service Co., Yankton, S. D., has used *Texaco Ursa Oils* for 20 years. Fairbanks-Morse engines in service include three Model 33 slow-speed diesels, one Model 38 OP high-speed diesel, and one Model 31 AD 18 dual-fuel unit.

**Northwestern** Public Service Company's Yankton, S. D., plant operates both straight diesel and dual-fuel engines—all of them lubricated with *Texaco Ursa Oil*. Mr. Elmer Leckrone, Plant Superintendent, says:

**"Never, in more than 20 years, has *Texaco Ursa Oil* 'let us down.' Our engines stay clean, wear is negligible, and we enjoy real fuel economy."**

This experience is typical. *Texaco Ursa Oil* does a great job of keeping engines clean. It stands up under heat and pressure...stands off oxidation and sludging...keeps rings free for proper compression and combustion. This means you'll use less fuel... spend less for maintenance.

There is a complete line of *Texaco Ursa Oils* to give your diesel, gas or dual-fuel engines the best "run" for your money. Leading engine builders O.K. them; operators everywhere use them. In fact—

**For over 20 years, more stationary diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.**

Get the full story from your Texaco Lubrication Engineer. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

## TEXACO URSA OILS

**FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES**

TUNE IN . . . TEXACO STAR THEATER starring DONALD O'CONNOR or JIMMY DURANTE on television . . . Saturday nights, NBC.

# Power

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# ...with Power readers...

TWO HELPFUL TIPS

How come? No thumbnail sketch of a contributor to "Plant Problems" in the March issue.

The Packing Manual, also in March, is a dandy. Every morning we assemble the plant crew for 10 minutes and review these manuals—clear and easy to understand. The men learn a lot about a so-called simple item.

*Canby, Minn.* S KRONE

EDITOR'S NOTE: *Schedule for thumbnail sketches is a bit flexible, but we intend to run one every other month. Watch for them.*

*Why not try Krone's idea in your plant? It should help in furthering an operator's education—and his job know-how.*

YES, BUT . . .

Why didn't you give us some really hot tips and tricks—on how to cope with the packing in close-coupled centrifugal pumps?

I've been struggling with repacking these pumps for over 20 years and still haven't found a good, easy way to do the job quickly and well.

My chief complaint is you didn't give us any hints—to get the old packing and lantern rings out.

PHARR, TEXAS *A F Doneis*

# ...lines and bylines

**PROMOTIONS** are big events in any family and the POWER family is no exception. So we know you'll be interested in the new responsibilities Editor Lou Rowley has assigned to Ben Skrotzki, Steve Elonka, Ty Hicks and Jim O'Connor, and will want to wish them well.

As you read about these assignments below, you'll see the outlines of a new staff structure. It's a lineup designed to deploy the skills and experience of these senior men in a continuing program of expanding and improving POWER's editorial service. Watch for its results in the pages of your magazine and let us know what you think about it.

**BEN SKROTZKI**, with POWER since 1945, is now associate editor in charge of the Engineering and Management section. To the continued development of the scope and content of this section, Ben brings a long background of experience in power engineering.

In addition to these direct administrative responsibilities, Ben will act as principal technical advisor to the Editor and as his representative in various engineering activities.

**STEVE ELONKA** might well be known to POWER readers as "Mr Maintenance." The practical manuals and articles he has written and the departments he has edited have long been high spots for plant operating men.

Now, as associate editor in charge of the Plant Operation and Maintenance section, Steve will bring his wide experience to bear on the job of still further increasing the usefulness of this popular section.

**TY HICKS** takes on a new job tied up with a long-standing POWER feature—the special reports that have been published regularly since 1935.

As associate editor in charge of Special Projects, Ty will sweat it out on the firing line with the technical editors preparing these manuals of current practice. With the single aim of making each better than the last, he will guide and coordinate planning, research and production.

**JIM O'CONNOR**, as managing editor, becomes anchor man of this editorial team. In this spot, his activities, while largely anonymous, will have a very direct bearing on the editorial service POWER renders its readers.

In addition to his responsibility for supervising the presentation and production of POWER's regular editorial content, Jim will continue to devote time and energy to his specialties—electricity and lubrication.

B&W Integral-Furnace Boiler with its control panel at Mill No. 3 boiler plant of Highland Park Manufacturing Company. Presently coal-fired with Detroit RotoStoker, the boiler is designed for future oil and gas firing. B. O. Vannort Engineers, Inc., are the consulting engineers for this installation.

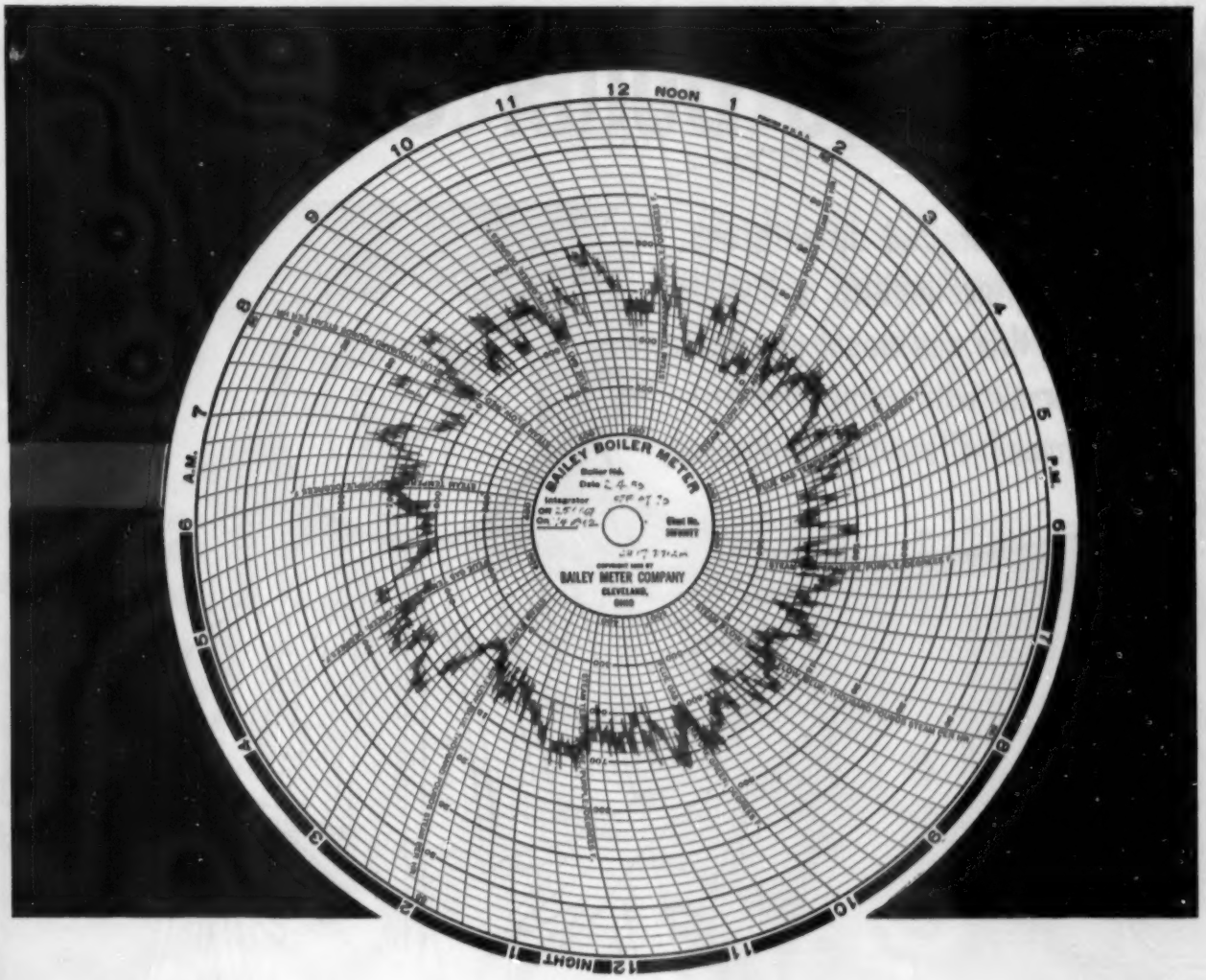
## HIGHLAND PARK MANUFACTURING COMPANY

# Saves 20% on

## with a B&W Integral-Furnace Boiler

When a study of boiler plant costs confirmed that boiler and auxiliary facilities at Highland Park Manufacturing Company's Mill No. 3, were inadequate and costly, a B&W Integral-Furnace Boiler was installed to replace one of the two old steam units in the plant. Other charges and replacements, including steam piping and ducts and a coal-handling system, were made at the same time. And from the day the new equipment went into operation the boiler plant started to pay for itself. An indication of actual savings is shown by the 706-ton annual reduction in fuel consumption—a full 20 per cent saving and in itself strong justification for the plant's modernization.

The new B&W Boiler provides 25,000 lb of steam per hr, and 27,500 lb per hr to meet peak loads. Designed for a pressure of 250 psi, the boiler is currently being operated at about 150 psi. Coal-fired, it has provision for future installation of oil- and gas-firing equipment without disturbing the stokers, to derive full benefit from fuel price fluctuations. Also, this new unit assures a constant and reliable steam supply with quick response to the wide load swings common in the course of normal operation. It is equipped with complete controls, an alarm system and other protective devices to minimize manual operation and supervision. In addition to fuel savings, the Company reports overall




# Fuel Alone

boiler efficiency consistently high, the plant much cleaner than before, and maintenance costs reduced substantially.

Highland Park Manufacturing Company and many other industrial plants in various categories have found B&W Integral-Furnace Boilers ideally suited to their steam requirements. If you are considering steam plant modernization or expansion to improve efficiency, get full details concerning B&W Integral-Furnace Boilers, available for steam requirements from 2900 to 350,000 lb per hr. Write to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

**COST-SAVING FEATURES**

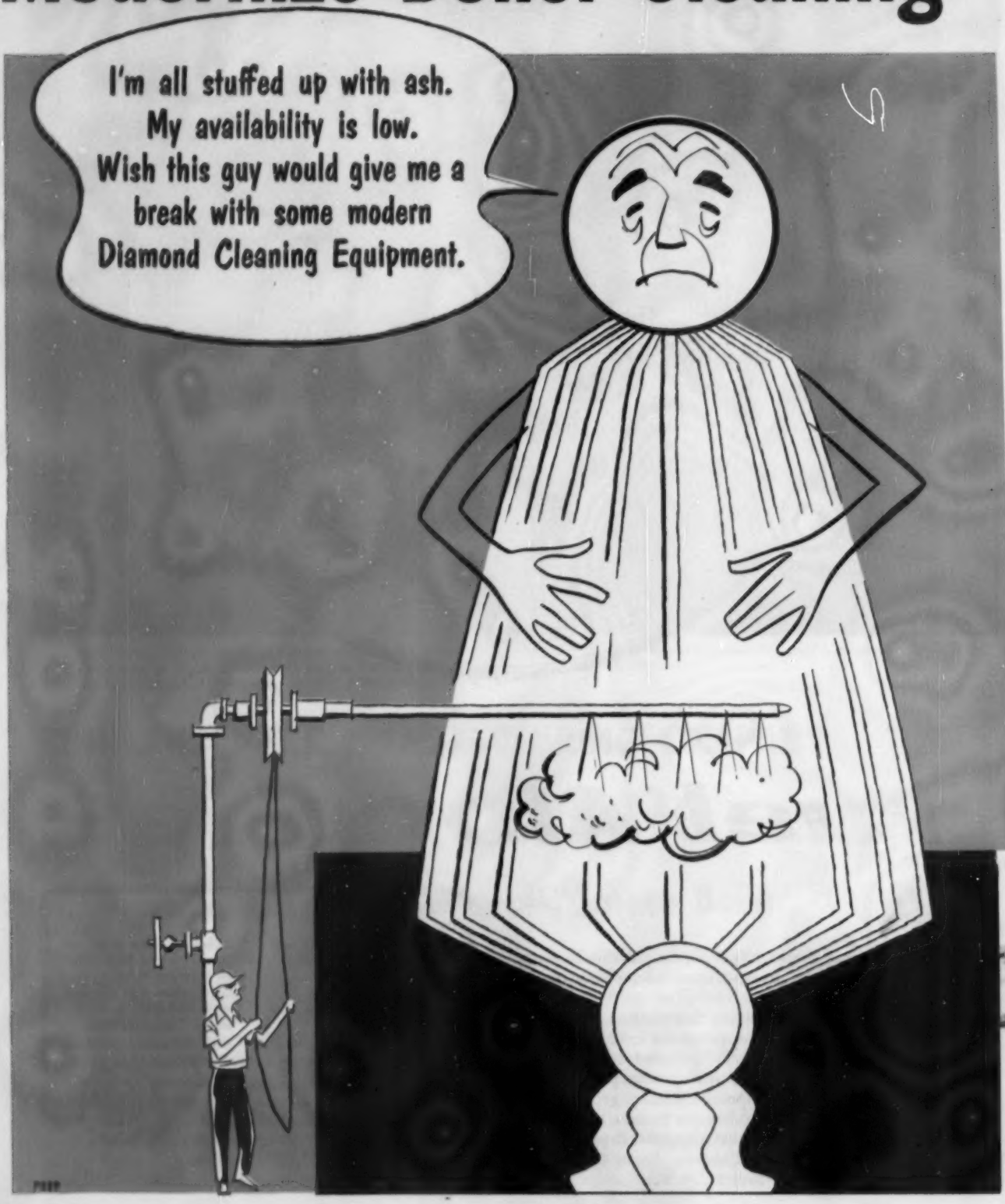
- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

**BABCOCK & WILCOX**

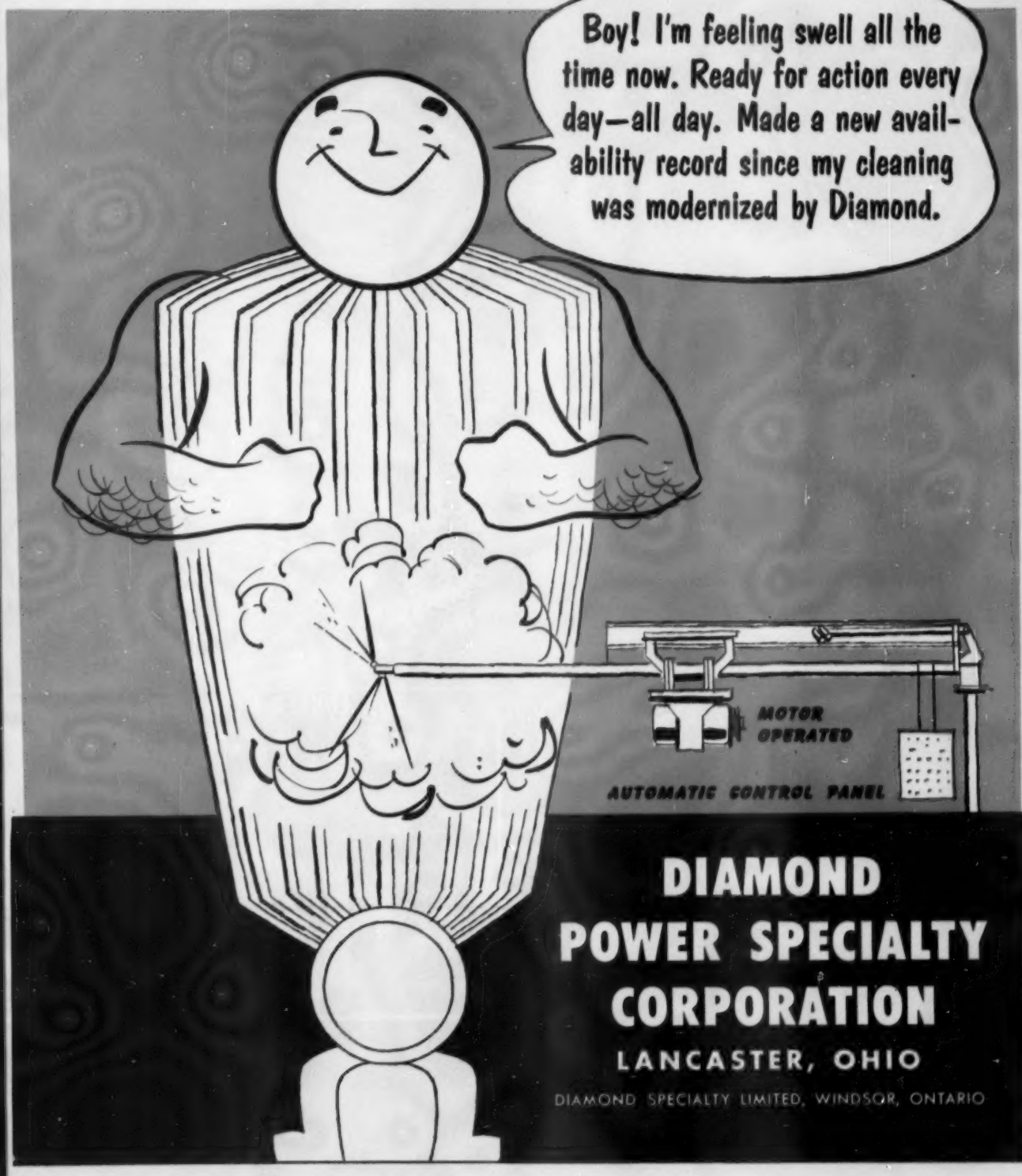
BOILER DIVISION

G-707

# Modernize Boiler Cleaning


I'm all stuffed up with ash.
My availability is low.
Wish this guy would give me a
break with some modern
Diamond Cleaning Equipment.

# to IMPROVE AVAILABILITY


Boy! I'm feeling swell all the time now. Ready for action every day—all day. Made a new availability record since my cleaning was modernized by Diamond.
MOTOR OPERATED
AUTOMATIC CONTROL PANEL

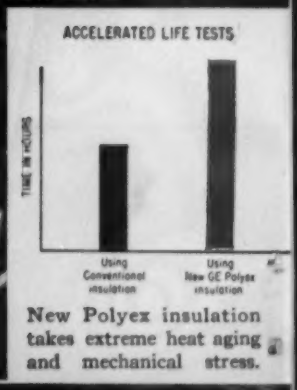
**DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

DIAMOND SPECIALTY LIMITED, WINDSOR, ONTARIO

**AN ELECTRODE'S EYE-VIEW** of a high voltage blast shows how General Electric's new Polyex insulation can withstand greater voltage—without breakdown—than any other Class A insulation in use today.

## 50% LONGER MOTOR LIFE




New Polyex insulation takes extreme heat aging and mechanical stress.

**For users of motors from 100 to 3000 hp...**

# G.E. Develops NEW Insulation That Is 7 Times Tougher—Adds 50 Percent to Motor Life

## Revolutionary *POLYEX* insulation gives added margin of protection against motor failures—reduces maintenance costs.

General Electric has developed a complete new insulation for form-wound coils which lasts 50% longer than any other Class A insulation in use today. Its greater ability to withstand physical and thermal stresses, and resist contaminants, provides an added margin of protection that will mean tremendous savings to you because of reduced motor failures and reduced maintenance costs.

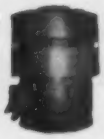
**POLYEX INSULATION** is a balanced system of polyester films and fibres, together with new hydrocarbon resins. For the first time, materials used are inherent insulators in themselves, and the cotton and paper-based tapes and sheets, used in conventional insulations, have been eliminated.

**A FEW OF THE EXHAUSTIVE TESTS** on new Polyex insulation are summarized on these pages. Insulation qualities like these offer you tremendous savings in motor maintenance and a greater degree of service continuity than ever before possible.

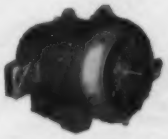
**FOR FURTHER INFORMATION,** contact your nearby G-E Sales Representative, or write for Bulletin GED-2460, Section 830-15, General Electric Co., Schenectady 5, New York.

### *HERE ARE G-E LARGE MOTORS EQUIPPED WITH POLYEX INSULATION*

**Vertical TEFC**



**Vertical Weather-Protected**



**Totally-enclosed fan-cooled**

**Open Dripproof**

**Grade-mounted weather-protected**

**Base-ventilated weather-protected**

**Totally-enclosed air-water cooled**

## 7 TIMES GREATER PHYSICAL STRENGTH

Cut through test proves G.E.'s new Polyex insulation has extra protection against much greater physical stress.

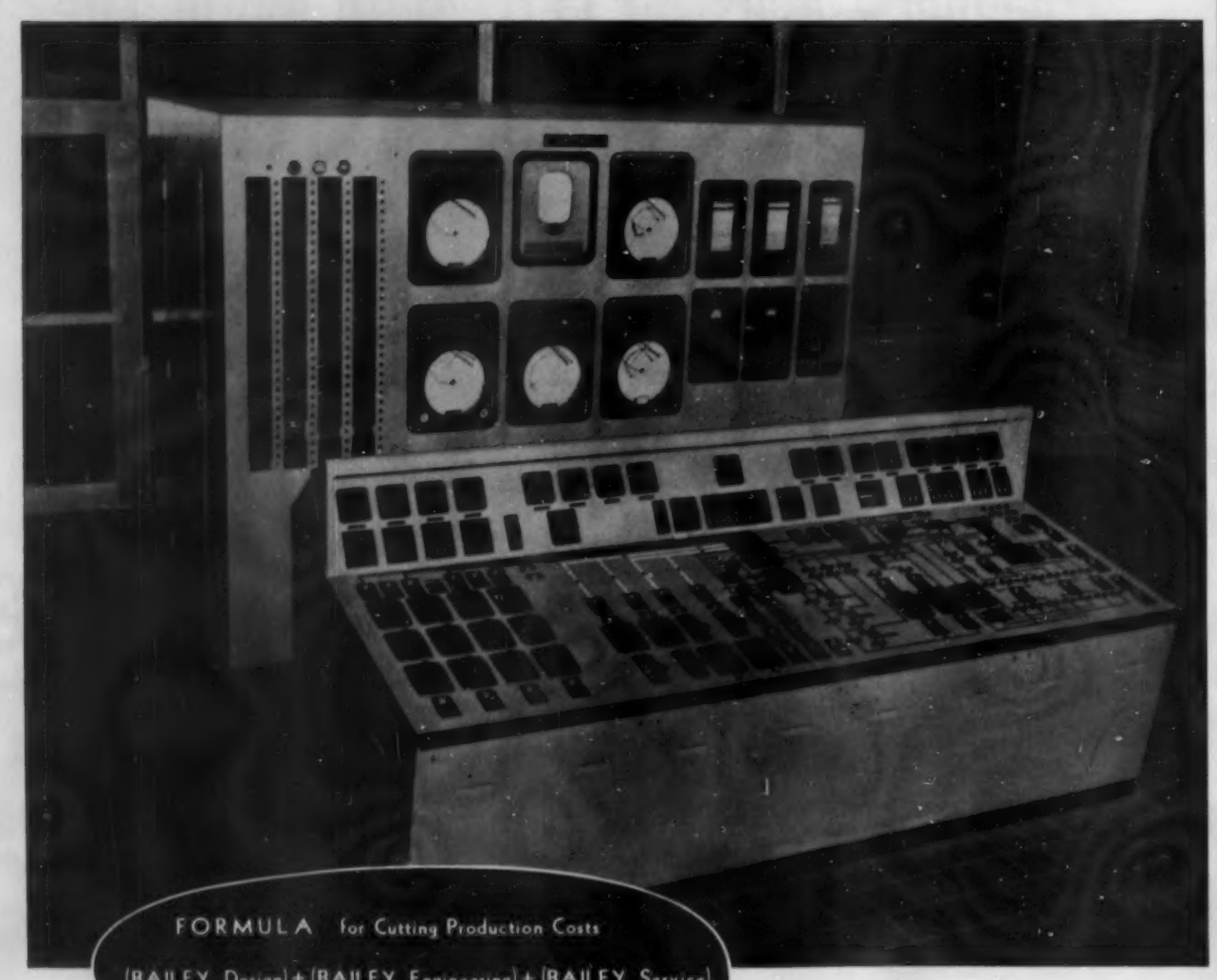
## 50% HIGHER DIELECTRIC STRENGTH

Tests prove new Polyex insulation can withstand much higher voltage stresses.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

# How to Increase the Return on



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Center for 60,000 kw reheat boiler-turbine Unit No. 1 at Danskammer Point Steam Station of Central Hudson Gas & Electric Corp. Bailey MINI-LINE Equipment on benchboard gives operators fingertip control while larger recorders on vertical board show operating trends and make permanent records. Duplicate Bailey Equipment has been purchased for Unit No. 2.

*Engineering and construction by Burns and Roe, Inc.*

# Your Boiler Room Investment

★ There are four important ways to increase the return on your Boiler Room Investment:

More power per fuel dollar
Less outage
Delivery of steam at design conditions
Greater operating safety

None of these items taken alone will produce the highest return—it takes all four working in close harmony.

That's where co-ordinated controls by Bailey Meter Company help. And here is why Bailey Controls are your best choice:

**1. Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

**2. Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

**3. Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more Industrial Centers than those of any other manufacturer of Boiler Control Systems; you get prompt, experienced service with a minimum of travel-time and expense.

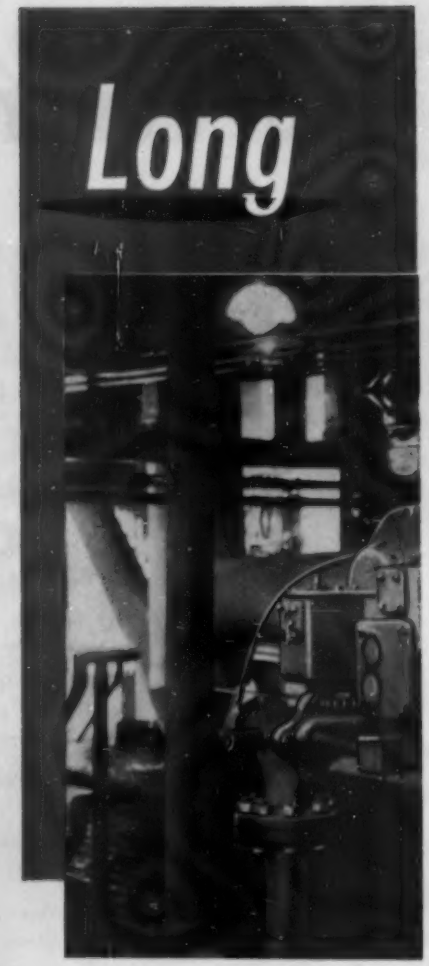
For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage, steam at design conditions, and greater operating safety—you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-115-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND, OHIO
*Complete Controls for Steam Plants*

BAILEY METERS
*Controls for*
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

# VULCAN *because of...*




**DUAL MOTOR DRIVE**

Vulcan uses two motors. One extends and retracts the lance. The other rotates it. Motors may be air or electric. Speeds are independently adjustable.

**JET AND LANCE DESIGN**

Vulcan offers jets tailored to the job—straight bore or venturi; and angled to reach specific surfaces. Jets normally rotate while traversing, but may traverse only or oscillate through any angle. Lances from opposite sides of the furnace may fail to "meet" by as much as 12 feet, yet clean thoroughly.

**CHOICE OF BLOWING MEDIUM**

You can blow with any medium—air, steam or water, or any combination of them—*without change of equipment.*

**CONTROL OF PACE**

Two motors allow step-and-go indexing with uniform rotation—or fast-and-slow change of pace. On "stop and go," the lance is stopped and rotated to clean the tubes—then sped across the open areas to the next row of tubes. On "fast and slow," the lance is slowed to clean the tubes, and sped while passing open areas. In each case, the result is a saving of blowing medium.

**VULCAN *Automatic***

# Retracts clean better

Vulcan Long Retracts clean better—with fewer outages, at lowest cost. They are engineered for optimum performance under varying conditions. They work equally well at any angle. They give you the benefit of dual-motor operation—one motor to traverse the lance, a second to rotate it. *Rotation is always in the same direction.* Repeated cleaning cycles result in an infinite number of double-helix paths that continually broaden the cleaning coverage. Lances can pass through as little as four inches of tube clearance. Write for Bulletin 1002.

**COPES-VULCAN DIVISION**

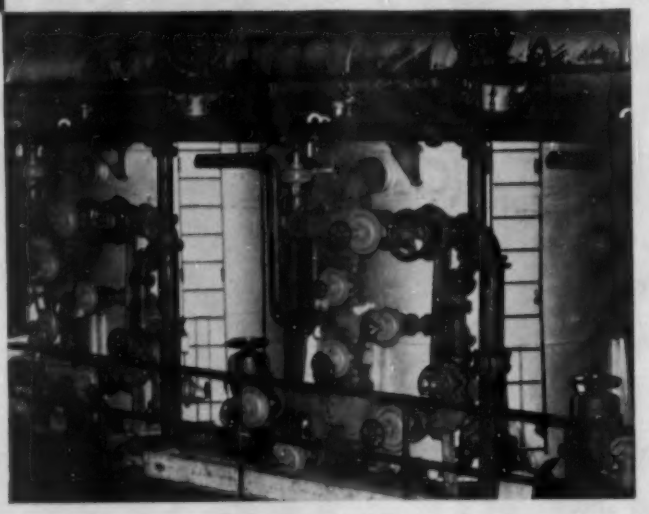
CONTINENTAL FOUNDRY & MACHINE COMPANY

**ERIE 4, PENNSYLVANIA**

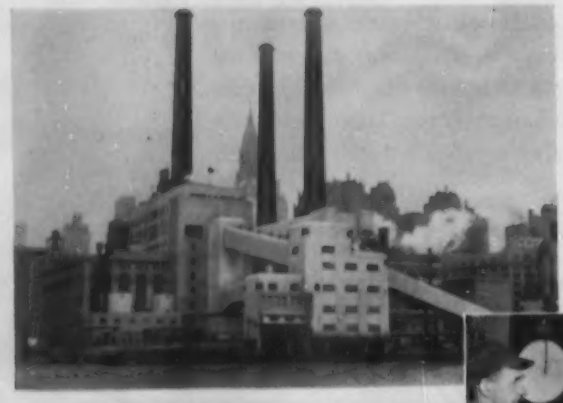
# ILLCO-WAY REDUCE MAXIMUM

Above, a view of part of the completed ILLCO-WAY Automatic Mixed-Bed De-Ionizer installation, showing how the IonXchange tanks are ranged along one wall of the turbine room.

Right, a closer view of two of the six huge tanks used to de-ionize the make-up requirement of over 2,000,000 lbs. per hour. This picture, which was made before final insulation and painting, gives some idea of the structural problems involved in supporting these tanks 30 feet above the floor level.



## CONSOLIDATED EDISON WATERSIDE STATION, N. Y.



Above, Waterside Station of Consolidated Edison Company, New York City, where the automatic IonXchange system described here is installed.

This big plant is not only a 100% high-pressure station but, because of large steam sales for skyscraper heating, it has a maximum potential make-up requirement of as much as 2,500,000 lbs. per hour. Water supply and operating conditions were causing the silica concentration in the boiler waters to be of the order of 30 to 35 ppm, resulting in excessive fouling and serious losses. To solve this problem, an automatic mixed-bed de-ionizer system was chosen, after thoughtful analysis and a period of careful pilot-plant tests. The installation has brought the silica in make-up water down to only .01 ppm.

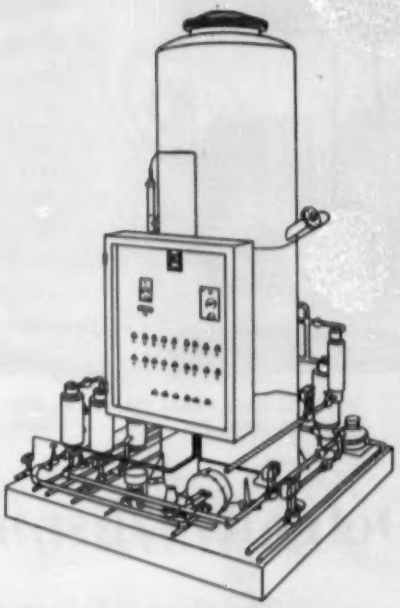
Left, close-up of some of the IonXchange indicating and control instruments supplied by the Industrial Division of Minneapolis-Honeywell Regulator Company.

# MIXED-BED DE-IONIZERS SILICA TO .01 PPM IN MAKE-UP OF 2,500,000 #/HR.

The Mixed-Bed De-Ionizer is one of the most remarkable pieces of water-treating equipment to be introduced since the advent of practical ionXchange. In this system, both anion *and* cation exchange resins are contained in *one* tank, and remain thoroughly intermixed during the service cycle. The result is that the water receives a great number of first cation and then anion exchanges — the equivalent of an enormous number of separate exchange tanks in series. The effluent thus is much more thoroughly "purified" than in the usual single pair of exchangers.

## SYSTEM HAS MANY ADVANTAGES

This Mixed-Bed system, which has now been developed into practical form, is particularly effective in the reduction of silica — which makes it of great interest to power plant operators, especially those with high-pressure boilers. In several recent installations, Mixed-Bed ionXchange equipment has proved to be more effective and much more economical than any of the other methods considered. It is also very compact, and requires a minimum of service and maintenance. Operation, after initial tests, is easily established, uniform, reliable, and understandable. Our representatives are equipped to discuss all the possibilities with you, and to make such recommendations as may be justified.



## NEW AUTOMATIC "PACKAGE" UNIT FOR LOW-MAKE-UP POWER PLANTS

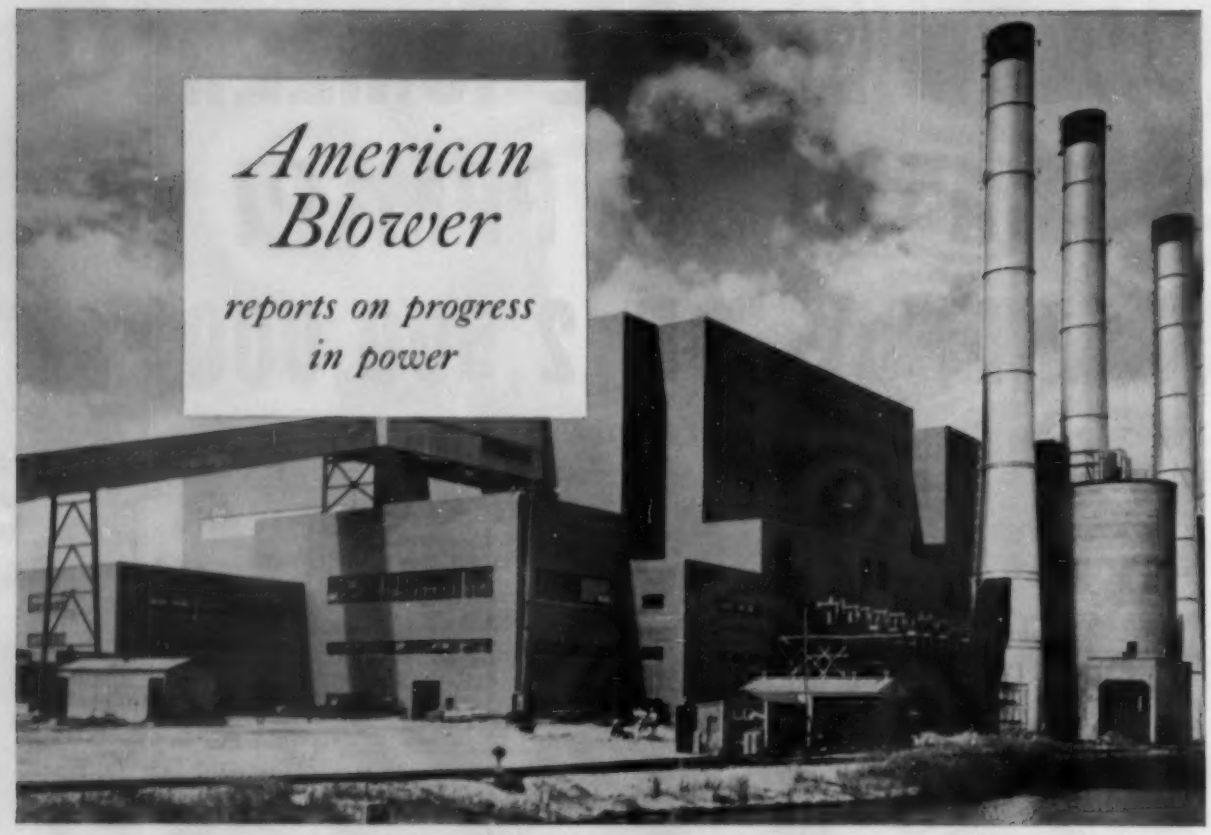
**Now, at reasonable cost, power plants with moderate make-up requirements can take advantage of the many benefits offered by ionXchange — by installing the compact and pre-assembled unit illustrated above. This is a complete Mixed-Bed De-Ionizer with all necessary indicators and automatic controls, including push-button regeneration, ready for hook-up in your water supply line. Please write for details.**

ILLCO-WAY

ionXchange

NEW YORK OFFICE: 141 E. 44th ST., NEW YORK 17, N.Y.
CANADIAN DIST.: PUMPS & SOFTENERS, LTD., LONDON, ONT.

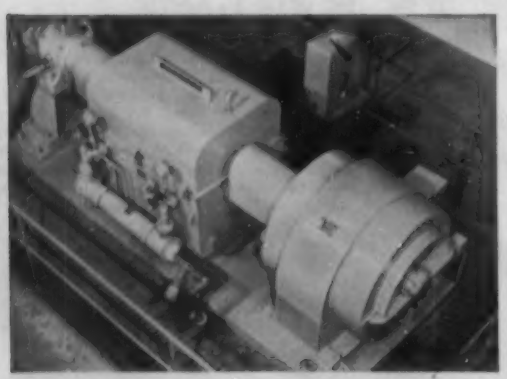
**ILLINOIS WATER TREATMENT CO.**
853 CEDAR STREET, ROCKFORD, ILLINOIS




**St. Clair Power Plant** is one of five stations in The Detroit Edison Company system. It was dedicated October 21, 1954, 75 years after Thomas A. Edison perfected the first practical light bulb. A sixth power station is under construction.

# Detroit Edison system demand reaches

**The Detroit Edison Company puts new generating units into service at St. Clair plant to meet Southeastern Michigan needs; relies on American Blower Gyrol Fluid Drives for boiler feed pump and fan control.**

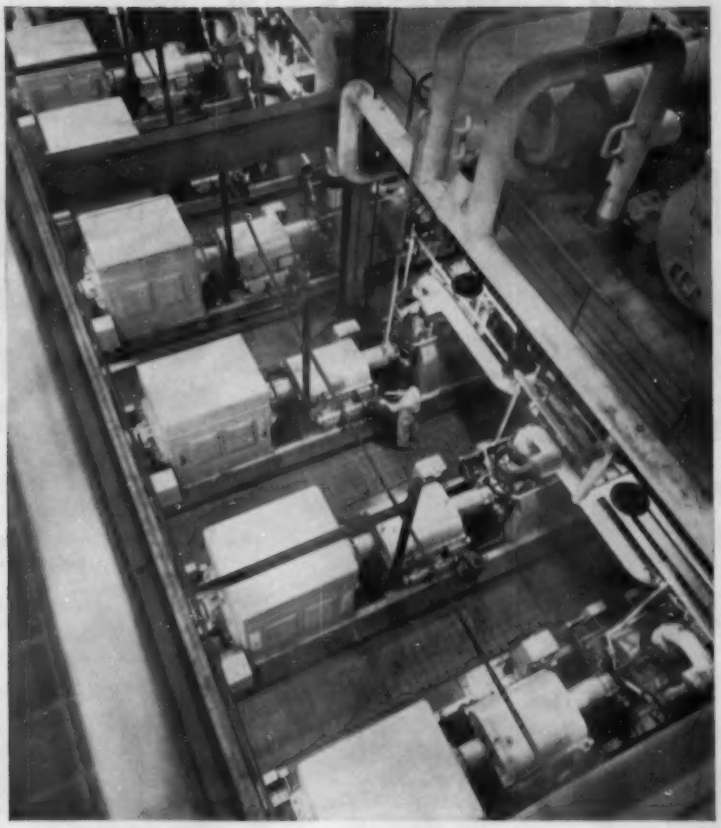


**American Blower,** Type VS, Class 4, Gyrol Fluid Drive unit drives induced draft fan on one of four boilers in Edison's St. Clair plant. 16 units deliver 15,000 h.p. to the mechanical draft fans.

By year's end, 1954, The Detroit Edison Company electric power system had developed a total capability of 2,535,000 kilowatts. Two new turbine-generators at Edison's St. Clair Power Plant went into operation, boosting the system's capability 312,500 kilowatts.

The boost was timely. A large increase in domestic customers, and very substantial additions of new industrial loads in Southeastern Michigan, had placed new power demands on the Edison system – 214,000 kilowatts more than the peak load for 1953.

*Serving home and industry:* **AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS •**



**American Blower** Gyrol Fluid Drives provide adjustable speed control for the boiler feed pumps at St. Clair station. Shown are six of twelve. Total capacity: 20,400 h.p.

# all-time peak of 2,236,000 kilowatts

### From concrete to kilowatts

The new St. Clair Power Plant serves Michigan's southeast area, with a total guaranteed capacity of 625,000 kilowatts. Construction of the plant began in February, 1951, and it now houses four giant turbine-generators, each with a 156,250 kilowatt capability. The first and second machines began operating in the fall of 1953; the third in June, 1954, and the fourth in October of that year.

Four boilers produce steam for the turbine-generators. Each unit has three combination boiler feed and heater feed pumps. American Blower Gyrol Fluid Drives are used to ensure smooth, adjustable speed control of the boiler feed pumps.

In its post-war expansion program, The Detroit Edison Company has incorporated American Blower Gyrol Fluid Drives to the extent of nearly 100,000 h.p. At the St. Clair Power Plant, these fluid drives deliver a total of 36,000 h.p. in driving the feed pumps and mechanical draft fans.

### Call on American Blower

If you are planning to expand or modernize your facilities, contact your nearest American Blower representative. He can recommend efficient, economical equipment – including Mechanical Draft Fans, Fly Ash Precipitators, Dust Collectors, Heavy Duty Steam Coils, as well as Gyrol Fluid Drives for boiler feed pump and fan control. Call your nearest American Blower Branch Office for full information.

**AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN**
**CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO**
Division of American Radiator & Standard Sanitary Corporation

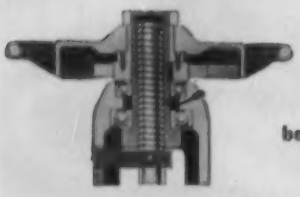
**AMERICAN BLOWER**

**KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS**

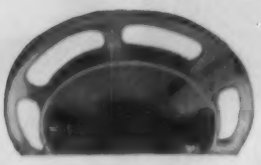
# You Get SPECIAL Features in

## THESE ARE EDWARD FIRSTS!

**IMPACTOR* HANDWHEEL**
Permits closing torque up to 2.8 times more than is possible with ordinary handwheel.



**EVALTHRUST* YOKE BUSHING** Patented ball bearing construction for easy valve operation.



**CLOSURE INDICATORS**
No guessing if valve is tightly closed for either regular operation or for special tests.

**LOW PRESSURE-LOSS BODY CONTOURS**
Both globe and angle bodies let maximum flow through. Pioneered by Edward. Copied but never bettered.

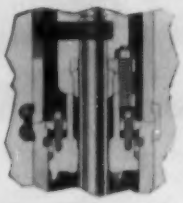
**THREE-POINT GUIDING**
Streamlined, cored out guide ribs, integral with body, keeps disk in alignment. Dangerous stem guiding eliminated.

**SELF-CENTERING DISK THROTTLING LIP**
Avoids jamming or cocking, assures tight seating, prevents wire-drawing.

*Registered trade names of Edward Valves, Inc.

**FREE FLOATING TUBULAR DISK-PISTON**
Quicker opening, surer closing, flow tested for less pressure loss.

**EQUALIZER***
Original design. Gives higher, surer piston lift, lowers pressure loss, eliminates wear-producing vibration.



**EDWARD PRESSURE-SEAL DESIGN** First pressure-seal non-return valves were built by Edward. Pressure-sealing parts do not guide floating disk-piston, insuring a permanent seal.

**INTEGRAL SEATS**
Hard facing applied directly to valve body completely eliminates possibility of leaks behind screwed or welded-in seat rings.

### *These are also Edward Firsts!*

Evalized* plating of valve parts for wear and corrosion resistance . . . Patented welded-bonnet Univalves* . . . Impactor* handles for small valves . . . Seat located guide ribs in gate valves . . . No-bonnet instrument valve construction . . . Stellited welded-in seats . . . Hour-glass type disk-piston . . . EValpak* packing . . . Separated feedline stop-check valves . . . Screwed and welded flanges for forged steel valves . . . Swing bolt retaining washer construction, and

***Patented Interchangeability of Stop, Check and Non-Return Valves . . . Greatest possible valve flexibility for your plant!***

## ROCKWELL-BUILT Edward VALVES

# STANDARD Edward Valves

## *Don't Settle For Less or Pay More*

Special high pressure applications call for special high pressure valves but not necessarily high-cost valves. Many of the Edward standard features are expensive "specials" for most valve manufacturers.

When you buy Edward Pressure-Seal globe and angle stop valves, you are buying proven quality, proven dependability, proven trouble-free service. You are buying standard valves with many special features that are exclusive and protected by patents.

Next time you need globe or angle stop valves, investigate Edward valves before you specify. It will pay you dividends in reduced installation and maintenance costs to compare Edward, feature for feature, with other valves. Many of the old Edward "firsts" are now industry standards and many of today's "firsts" will be industry standards tomorrow.

Always specify Edward. Only Edward Valves Equal Edward Quality and Performance.

## Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1230 West 144th Street, East Chicago, Indiana

Typical Edward Pressure-Seal globe stop valve design for 900, 1500, or 2500 lb. service at 1000 F.

Another Product

## MODERNIZING?

### *New equipment needs the right instrumentation*

When you're planning to install new equipment, plan to take advantage of the full potential of modern methods of measurement and control. It's the sure way to get top value for your modernization investment . . . for the improvements in production economy, quality, and versatility possible with today's production equipment depend increasingly on control instrumentation.

Here are two important points that deserve consideration if you're planning to modernize:

*1. Design for control.* Instrumentation is more than a necessary appendage. It's a vital, integrated part of the process itself. *Control design goes hand in hand with process design.*

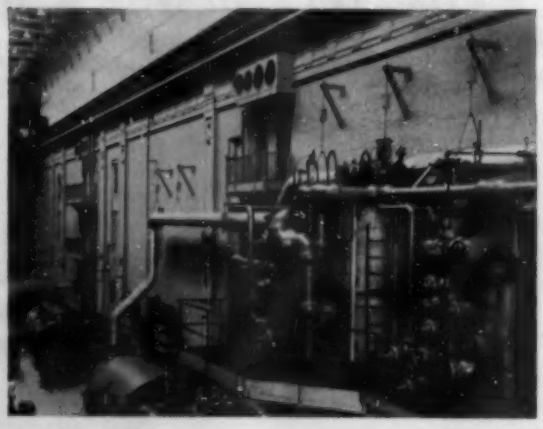
*2. Get the right instrument for the job.* This seems obvious—but all too often instruments may be stretched or squeezed to fit applications for which they were never intended. *Each instrument should fit its function.*

On point number 1, Honeywell's experienced application engineers will be glad to cooperate with your own staff to recommend ways in which you can obtain the full benefit of modern instrumentation. They have an extensive background not only in contact technology, but also in the processing problems of various industries.

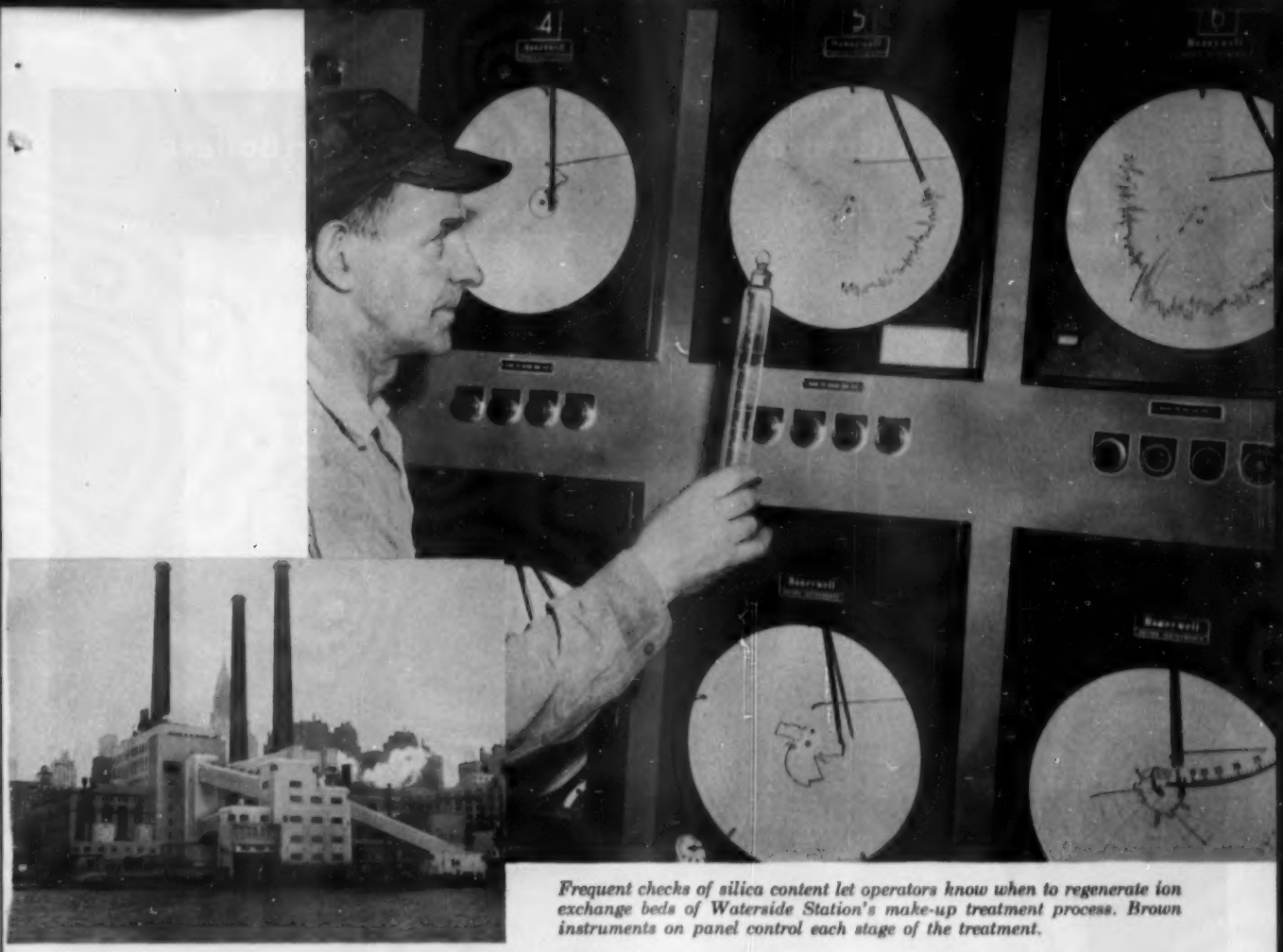
On point number 2, Honeywell offers an exceptionally wide line from which to choose. You're sure to find instrumentation with exactly the right performance . . . at the right cost . . . to fit your process. You eliminate problems of "shopping around" . . . and divided responsibility. This one source can fill practically all your measurement and control requirements.

A talk with your nearby Honeywell sales engineer will give you a detailed picture of what instrumentation can mean in your modernization program. Call him today . . . he's as near as your phone.

# Brown instruments help Con Edison station treat



*View of part of the installation of six "Illco-Way" mixed-bed de-ionizers, which reduce silica content of raw make-up water by ion exchange...under control of Brown instruments.*



*Frequent checks of silica content let operators know when to regenerate ion exchange beds of Waterside Station's make-up treatment process. Brown instruments on panel control each stage of the treatment.*

# 2 million pounds of make-up per hour

CONSOLIDATED EDISON'S Waterside station is a large, modern 100% high pressure station. And it had one of the biggest make-up water problems . . . for beside supplying its 658 megawatts of generating capacity, the station also feeds 200 psi steam to New York's skyscraper heating system. As much as 2½ million pounds of make-up per hour may be required.

To minimize scaling troubles due to silica content of the raw water, the station was recently equipped with "Illco-Way" ion exchange treatment equipment that de-ionizes this large volume of water in a continuous, completely controlled system. Designed and built by Illinois Water Treatment Co., the one-million-dollar system consists of six mixed-bed de-ionizers. The installation is equipped with an extensive complement of Brown instruments that measure and control critical variables.

Separate Brown integrating flow recorders check the flow of softened water to each of the six mixed beds. A multi-point *ElectroniK* conductivity recorder charts the purity of effluents, as a check on operation . . . and operates alarms when conductivity gets too high. pH of treated effluent is recorded by another *ElectroniK* instrument, which also warns when pH drops too low. Other Brown instruments measure and control reagents and rinse-water flows and temperature during the regeneration of the individual ion exchange beds.

The net result is that make-up water with silica content consistently below 0.02 ppm, and conductivity about 1 micromho, is fed to the station's boilers . . . with only a minimum of individual attention by plant operators.

For a discussion of how Brown instruments can go to work advantageously in your own plant, call your local Honeywell sales engineer . . . he's as near as your phone.

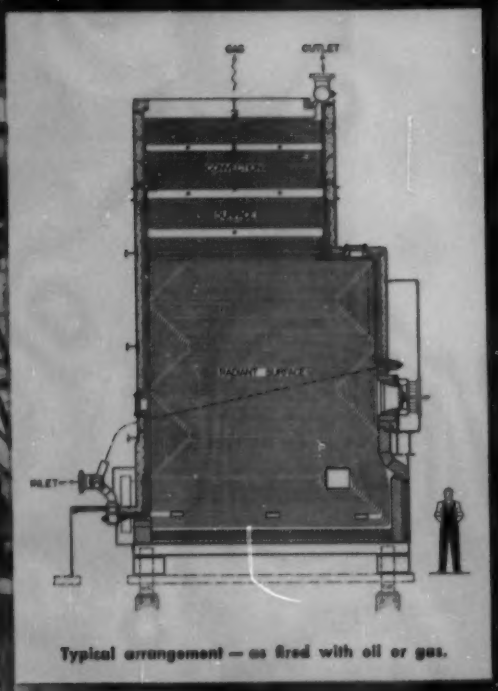
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:**
**Write for Catalog 90-2, "Supervisory Instruments for Power Generation."**

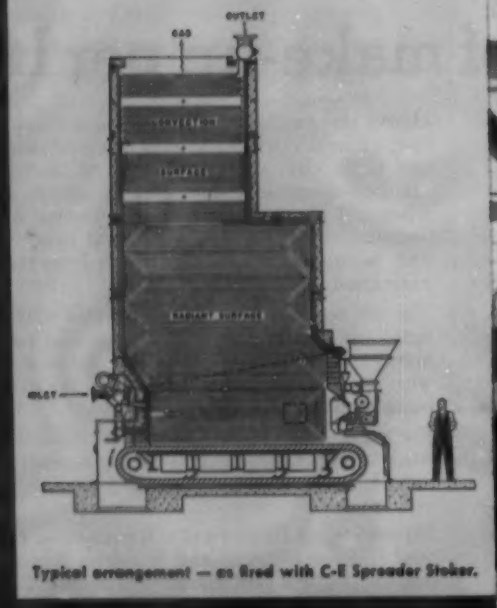
MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*

# C-E LaMont Controlled Circulation Hot Water Boilers

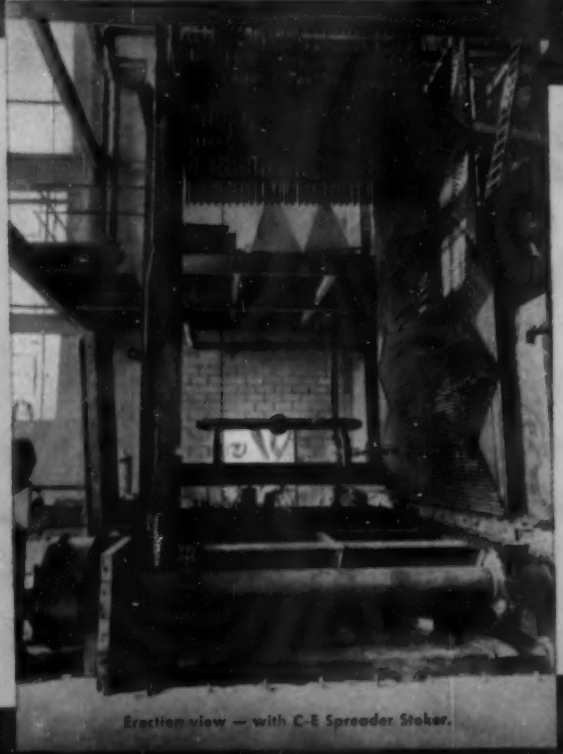
Installation view — oil fired unit.




Typical arrangement — as fired with oil or gas.




Typical arrangement — as fired with C-E Spreader Stoker.



Erection view — with C-E Spreader Stoker.

# Ever consider High Temperature Water for your heating and processing needs?

Both steam and high temperature water have their place, and your particular requirements will determine which is best for you. In either case the complete C-E line includes a type and size of boiler exactly suited to your requirements. Where high temperature (HT) water seems indicated, it affords such important advantages as:

1. The higher available heat in HT water . . . many times that of steam at the same pressure.
2. Closer control of temperatures throughout the system.
3. Heat loss is minor with the HT water closed system . . . no condensate losses . . . unused heat returns to the boiler.
4. No elaborate feedwater treatment required because make-up requirements are small.
5. No steam traps are needed, which means elimination of all trap problems and attendant expense.
6. No blowdown losses . . . no safety valve vent losses . . . no condensate return lines.

The planning of any new heating and/or processing system should give proper consideration to the suitability of the HT water system. There are many hundreds of HT water installations operating abroad and a rapidly growing number in the U.S.A. It may be *just right* for *your* requirements.

B-831

## *Advantages of the C-E Hot Water Boiler*

Once it is established that HT water is right for your needs, your next concern is selection of proper equipment. The C-E LaMont Controlled Circulation Hot Water Boiler has inherent advantages that make it the best possible choice. It is especially designed for HT water applications utilizing as it does the principle of forced, controlled circulation which is extended throughout the entire system. This accounts for numerous points of superiority in the C-E LaMont Hot Water Boiler. Among these are:

1. Complete control over HT water movement in both system and boiler.
2. Low pressure loss is inherent so no separate boiler pump is required.
3. Pressurized operation with oil or gas means no induced draft fan — simple stack.
4. Single-pass design — no baffles . . . low draft loss . . . cleaner boiler.
5. More efficient heating surface can be arranged because of positive, controlled circulation.
6. Other features such as: steel enclosed setting — few headers, all accessible — any fuel, oil, gas or coal.

The C-E Hot Water Boiler is available in sizes ranging from 15 to 200-million Btu per hour, or more, with pressures up to 300 psi and temperatures to about 425 F.

If you are in the market for a heating or process system — or expect to be — by all means investigate high temperature water and the C-E LaMont Hot Water Boiler. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our new catalog HT-101.

**COMBUSTION ENGINEERING**

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

# FLEXIDYNE

## THE DRY FLUID DRIVE

**DODGE of Mishawaka Announces An Entirely New Development in Industrial Power Drives that Promises to Revolutionize Drive Performance! Every Design Engineer and Plant Operating Man in America Will Want the Following Information.**

Here are the facts on how easily Flexidyne handles difficult starting problems, and gives a *new* kind of protection against shock and overloads.

While new in the United States, this drive has already been proved in thousands of installations in Europe. Dodge has redesigned it to American standards and now makes its dramatic advantages available to all industry.

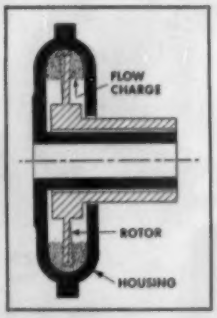
Flexidyne is a *dry fluid drive*. Its advantages over any other fluid-type drive are based on the fact that at normal operating conditions it *does not slip*.

### WHAT IT IS

The Flexidyne Drive is made up of a housing, inside of which a rotor is free to turn concentrically. Between the two are fine particles of spherical steel shot, called the "flow charge," which acts very much like a fluid. The flow charge transmits power from housing to rotor.

This flow charge is easy to seal in, has a high density and can stand relatively high temperatures. The use of this flow charge makes possible a design that is simple, compact, economical, and gives outstanding new and different operating characteristics.

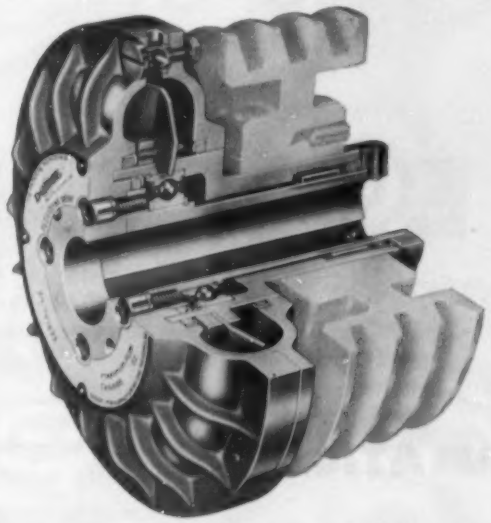
### HOW IT WORKS




1. The motor is connected to the housing, and starts it turning at no load.

2. The flow charge is thrown to the circumference of the housing, is compressed by centrifugal force, and revolves with the housing.

3. The rotor, connected to the load, is started and accelerated by the friction and wedging action of the revolving flow charge.



FLEXIDYNE DRIVE (with Taper-Lock Sheave in phantom).

4. Rotor and housing reach identical speeds—the Flexidyne operates with ZERO SLIPPAGE between motor and load at normal running speeds.

5. Before overloads cause damage, the Flexidyne rotor slips relative to the housing, overcoming the friction and wedging action of the flow charge. A thermal switch (optional) automatically cuts the electrical circuit if an overload persists.

6. The amount of the flow charge determines the torque capacity.

## WHAT IT DOES

The Flexidyne gives you the *exact* starting torque you need, for anything from the smoothest to the fastest start. Once the load reaches normal speed, there is zero slip, giving 100% efficiency. Also, it provides *accurate* overload protection, as it can be set to slip at any desired load. During starting and overload periods the current draw is at a minimum because with the standard Flexidyne setting the motor is never pulled down to less than 90% of synchronous speed.

All this is due to Flexidyne's completely new principle, which produces *constant torque* for a given input speed, regardless of the percentage of slip between the rotor and housing (which occurs only during starting or overload).

The Flexidyne is simple to select *off the shelf*. Each size has a standard horsepower rating and yet it is only a matter of minutes to vary the flow charge to give you your own *tailor-made torque* to suit the job.

With Flexidyne you get *uniform* performance regardless of changes in the surrounding temperature.

The Flexidyne has very long life and practically negligible maintenance. *Its simplicity guarantees its dependability.* Gas and diesel engines also benefit from all Flexidyne advantages.

Aside from Flexidyne's low first cost, low maintenance, and top efficiency, it permits the use of smaller, cheaper motors and controls with greatly reduced current demands and improved power factor. Its *smoother* starts and *gentler* overload protection avoid breakage and reduce maintenance on drives, gears, bearings and driven machinery.

## FLEXIDYNE COUPLINGS

Two lines will be available—*Flexidyne Drives,* for convenient mounting directly on motor shafts and adapted for Dodge Taper-Lock Sheaves, and *Flexidyne Couplings* with Taper-Lock Bushings, for straight line drives. Several thousands of these units of French design, in capacities ranging from fractional to thousands of horsepower, are now in use in Europe. Dodge will first offer — from stock — four sizes rated at 3 to 30 hp at 1800 rpm. Other sizes will follow.

Write now for special bulletin, delivery dates and application information.

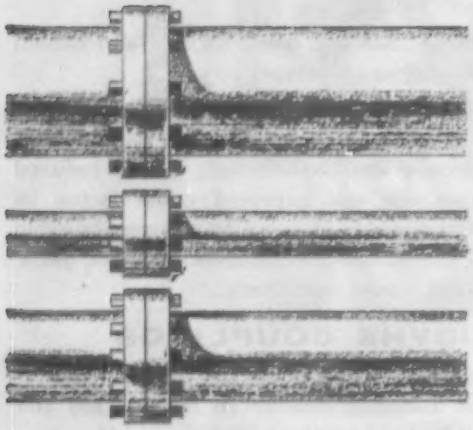
**DODGE MANUFACTURING CORPORATION**
**3200 UNION STREET, MISHAWAKA, INDIANA**

**CALL *THE TRANSMISSIONEER*,** your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

DODGE

of Mishawaka, Ind.

# This REPUBLIC
## *Combustion Control System*



## AUTOMATICALLY SELECTS LOWEST COST COMBINATION OF THREE AVAILABLE FUELS

Three fuels — blast furnace gas, coke oven gas, and fuel oil — are burned by three 125,000 lb. per hr. steam generating boilers at a large midwestern steel plant.

In addition to maintaining the proper fuel-air ratio and holding steam pressure constant at all loads, a Republic Control System automatically makes fuel selections according to the amount of by-product blast furnace gas available. At times when this low cost gas is plentiful, it is used as the primary fuel. The other two fuels are used only for make-up when available blast furnace gas cannot meet all of the fuel demand. If the blast furnace gas pressure falls below a predetermined minimum, however, flow is automatically reduced and one of the other two fuels also burned.

This dual purpose Combustion Control System cuts fuel costs two ways:

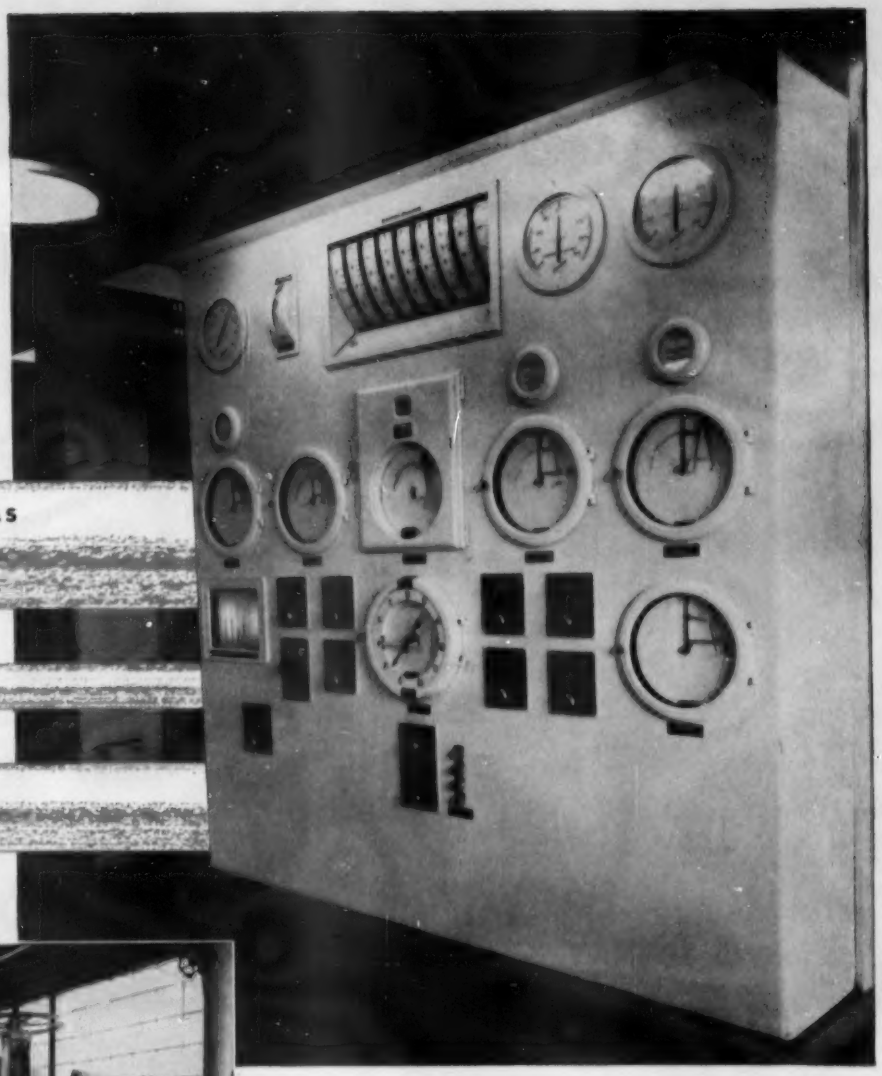
(1) Because of efficient combustion, less fuel is used for a given steam output.

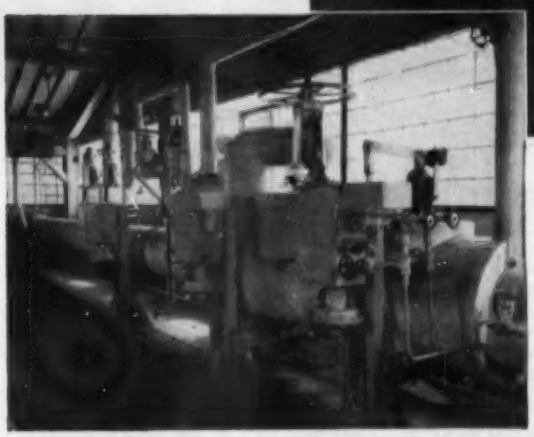
(2) As much lowest cost fuel is used as possible.

Control Systems such as this one further illustrate how Republic engineers can design combustion controls that make the most of fuels available. Very likely, Republic can show *you* ways to get more power at less cost — automatically.

**REPUBLIC FLOW METERS CO.**

Boiler panel at steel mill power plant includes sub-panels and instruments for multi-fuel firing system. The boiler draft and fuel selection may be controlled manually from this panel, if desired.



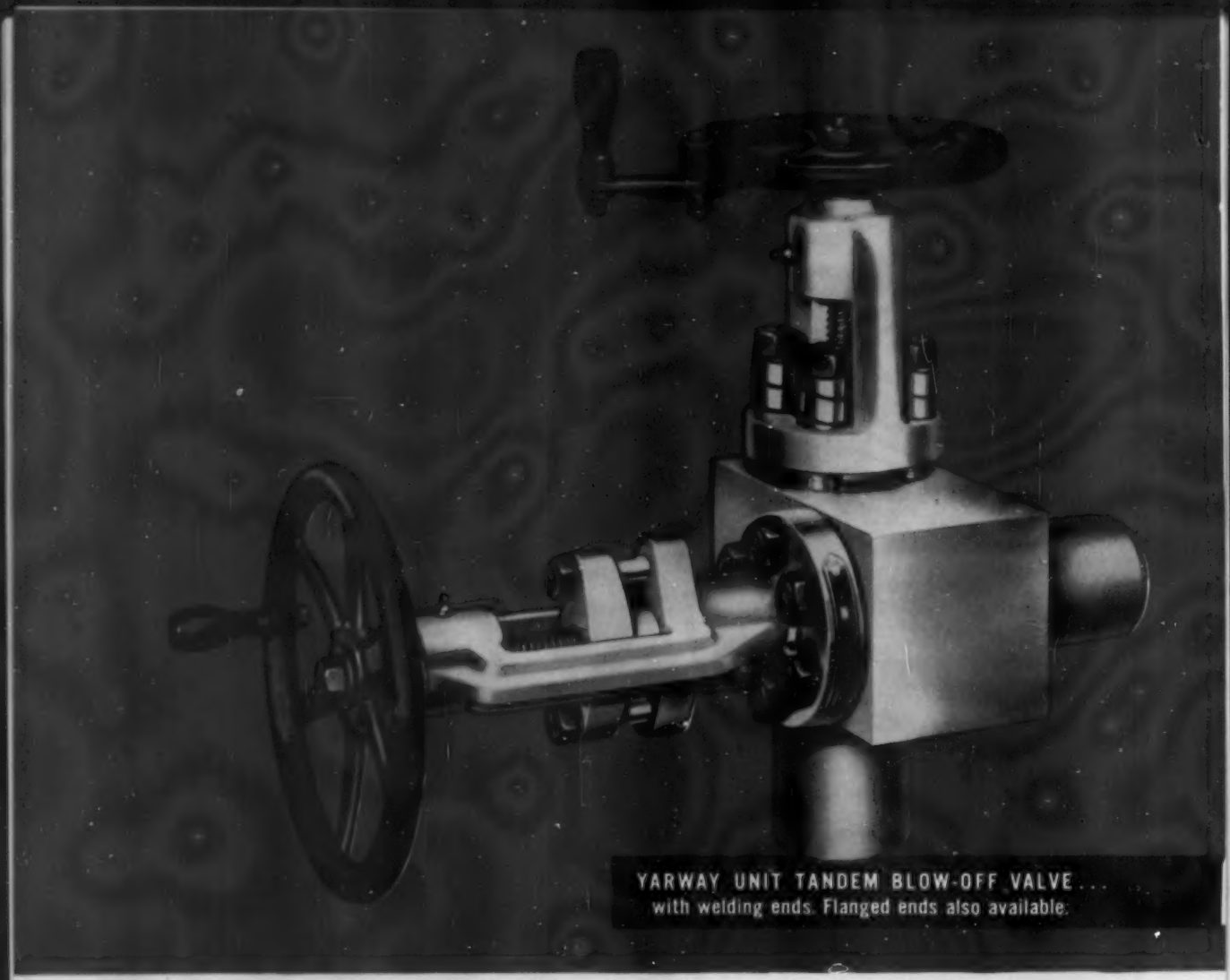



Pressure Reducing and Desuperheating Station furnished by Republic drops steam from 425 psi and 750°F. to 500°F. and 250 psi max.—180 psi min. High and low pressure safety regulators at the desuperheater station protect the boiler system from unusual steam demands.

**REPUBLIC AUTOMATIC COMBUSTION CONTROLS**

- ★ For all types and sizes of boilers
- ★ For all types of fuel
- ★ For all types of firing
- ★ For all arrangements of draft
- ★ For all load conditions

2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



YARWAY UNIT TANDEM BLOW-OFF VALVE . . .
with welding ends. Flanged ends also available.

## BUILT TO "TAKE IT" AT

# HIGH PRESSURES

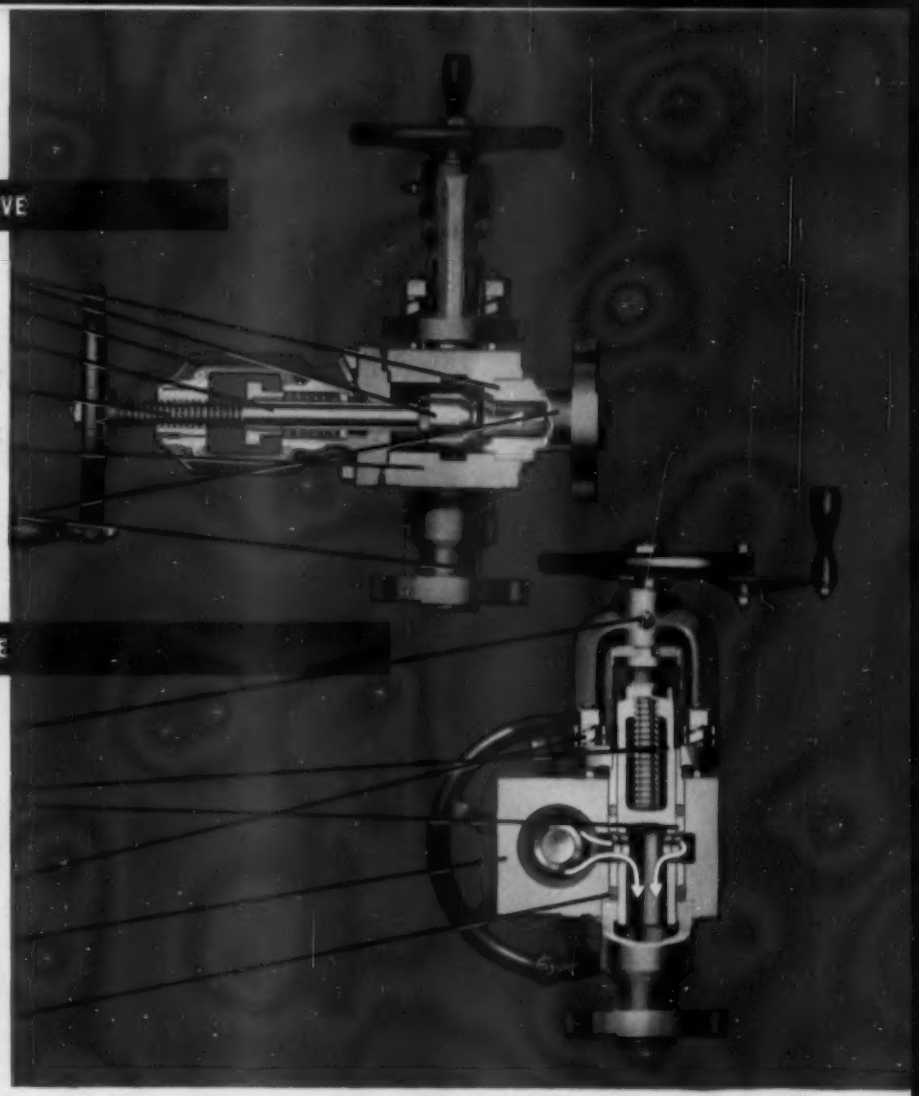
● As boiler pressures go up . . . so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES



## HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

## SEATLESS (Sealing) VALVE

Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.

Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

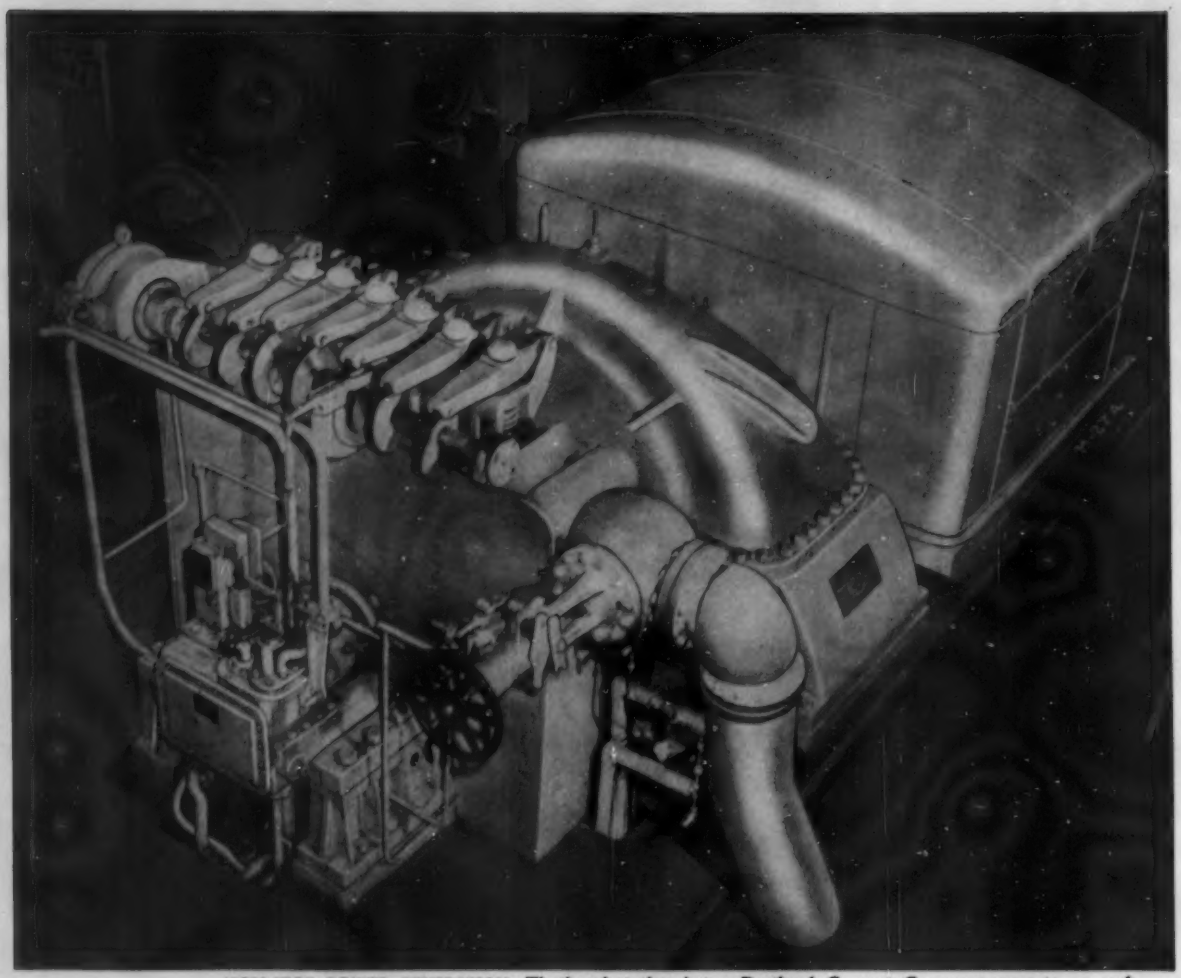
**YARNALL-WARING COMPANY**

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

**YARWAY® blow-off valves**

INDUSTRIAL PLANTS



**NON-STOP POWER GENERATION.** That's what the Aetna Portland Cement Company expects — and gets — from its 5000-kw Worthington turbine-generator despite the roughest kind of operating conditions.

# Runs 52,500 hours without a break

Six years of 24-hour-a-day operation without a stop, except for annual plant shutdown.

That's the record this 5000-kw Worthington turbine-generator has chalked up at the Aetna Portland Cement Company's plant in Bay City, Michigan.

Installed in 1948, the rugged Worthington unit is the main source of power for this cement plant, operating at full load (often at 20% overload) in an atmosphere of highly abrasive dust.

One big reason why Aetna, like so many other leading industrial firms, chose Worthington is the undivided responsibility that goes with every Worthington turbine-generator. Both the Worthington turbine and generator are designed to operate as *one* unit and are assembled and completely tested *before* shipment.

For more facts about Worthington turbine-generators, write to Worthington Corporation, Steam Turbine Division, Section T.4.8, Wellsville, N.Y. T.4.8

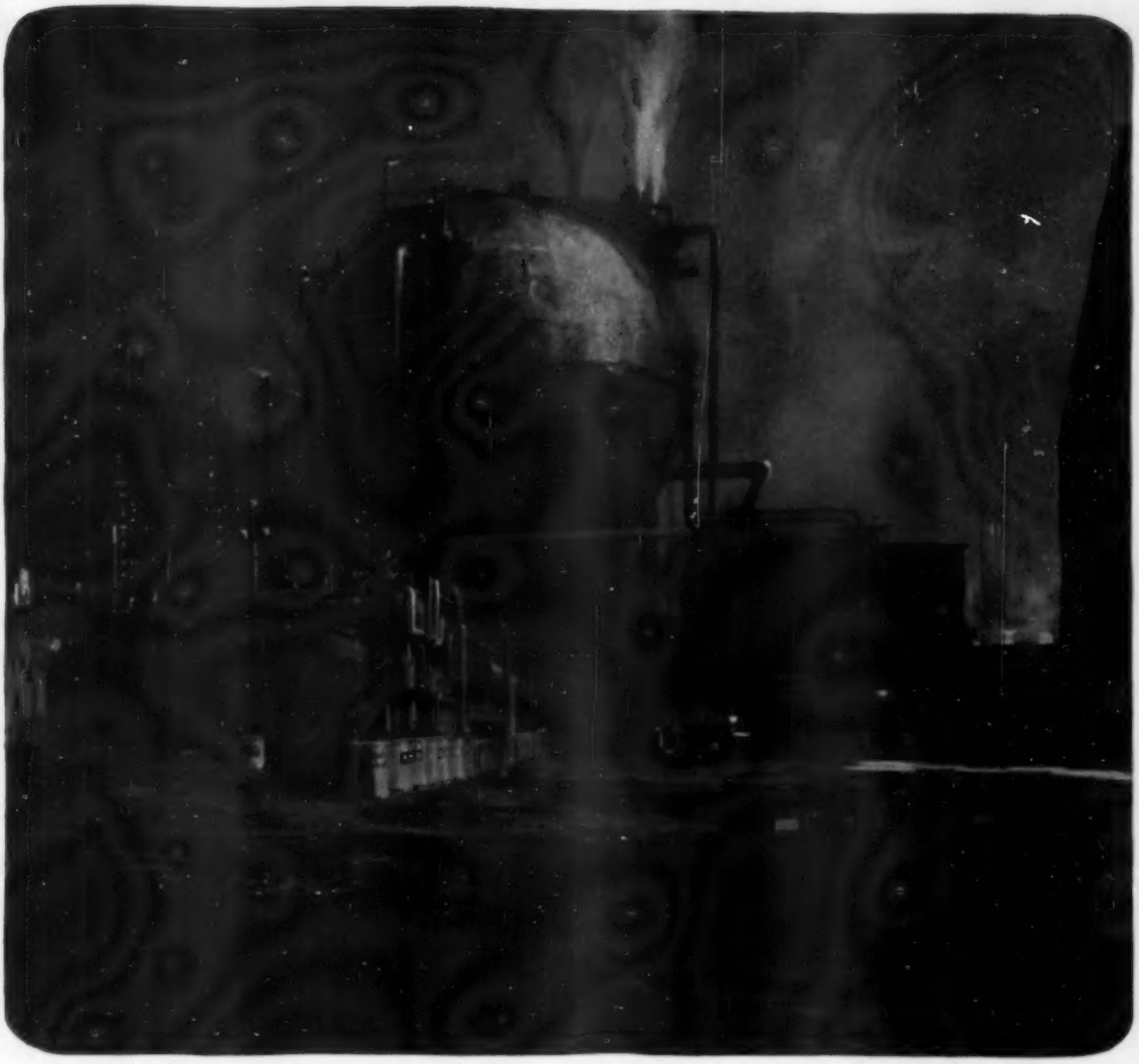
**"SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street."**

**WORTHINGTON**

**STEAM TURBINES**

**Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers**

**A GREAT TEAM IN STEAM**



# Water refined here

An oil refinery uses prodigious quantities of water for boiler-feed, processing, and cooling. To meet its requirements for properly softened water, this giant refinery treats hot, raw water with AMBERLITE® cation ion exchange resins and lime. The process is efficient, economical, and yields water of "zero" hardness.

What's your water problem? Softening? Dealkalization? Deionization? Deacidification? As long as it involves the removal or replacement of dissolved salts, there's an AMBERLITE ion exchange resin ready to help you. You can call on 11 different commercially available Rohm & Haas resins in varying degrees of acidity, basicity, and porosity. Ask your equipment manufacturer or consulting engineer about ion exchange and why the resin that's *right* is AMBERLITE.

*Write for "If You Use Water," 24 pages of information on treating water by ion exchange.*

**ROHM & HAAS COMPANY**

THE RESINOUS PRODUCTS DIVISION, PHILADELPHIA 5, PENNSYLVANIA

# PHILADELPHIA "HI-SPEED" SPEED REDUCERS AND INCREASERS

The new standardized Hi-Speed units contain all the features and advantages of "custom built" gear reducers. These rugged Philadelphia drives, available for both Industrial and Air Conditioning Service, are designed and manufactured specifically for the reducer or increaser application where rotating speeds range as high as 9000 RPM or pitch line velocities up to 10,000 feet per minute.

All rotating gears and shafts are dynamically balanced to provide the ultimate in vibration-free power transmission. Philadelphia Hi-Speed Units meet the modern trend toward higher prime-mover speeds of steam turbines, ultra high speed electric motors and internal combustion engines for driving compressors, pumps and mills through Speed Reduction Units. They are also used as *Speed Increasers* to drive high speed compressors, generators, pumps and fans.

**DESIGN** — in accordance with latest practices of the American Gear Manufacturers Association.

**HORSEPOWER** — from 1 HP to 7100 HP.

**SPEED** — to 9000 RPM and pitchline velocity of 10,000 fpm.

**RATIOS** — from 1:1 to 10:1 for either speed reduction or increase.

**HOUSINGS** — are quality gray cast iron of generous proportion, with heavy bearing bosses to provide rigid mounting for rotating parts.

**GEARS** — are double opposed helical type, designed to spread tooth load over three or more teeth. Thrust forces produced by helical gearing are completely balanced by opposed helical faces. Gear and pinion teeth are cut by hobbing process, finish-shaved to produce most accurate tooth contours. Gearing is dynamically balanced. Gears are manufactured from stress relieved alloy steel castings.

**SHAFTS** — are completely machined, with bearing surfaces hardened, ground, and polished.

**BEARINGS** — are babbitt lined, bronze backed precision type "sleeve" construction, which have become synonymous with high speed shaft rotation.

**LUBRICATION** — positive, force - feed, self - contained system, with spray nozzles to entire gear face at line of contact, and separate pressure lines to each bearing.

*Send for Catalog HI and be convinced*

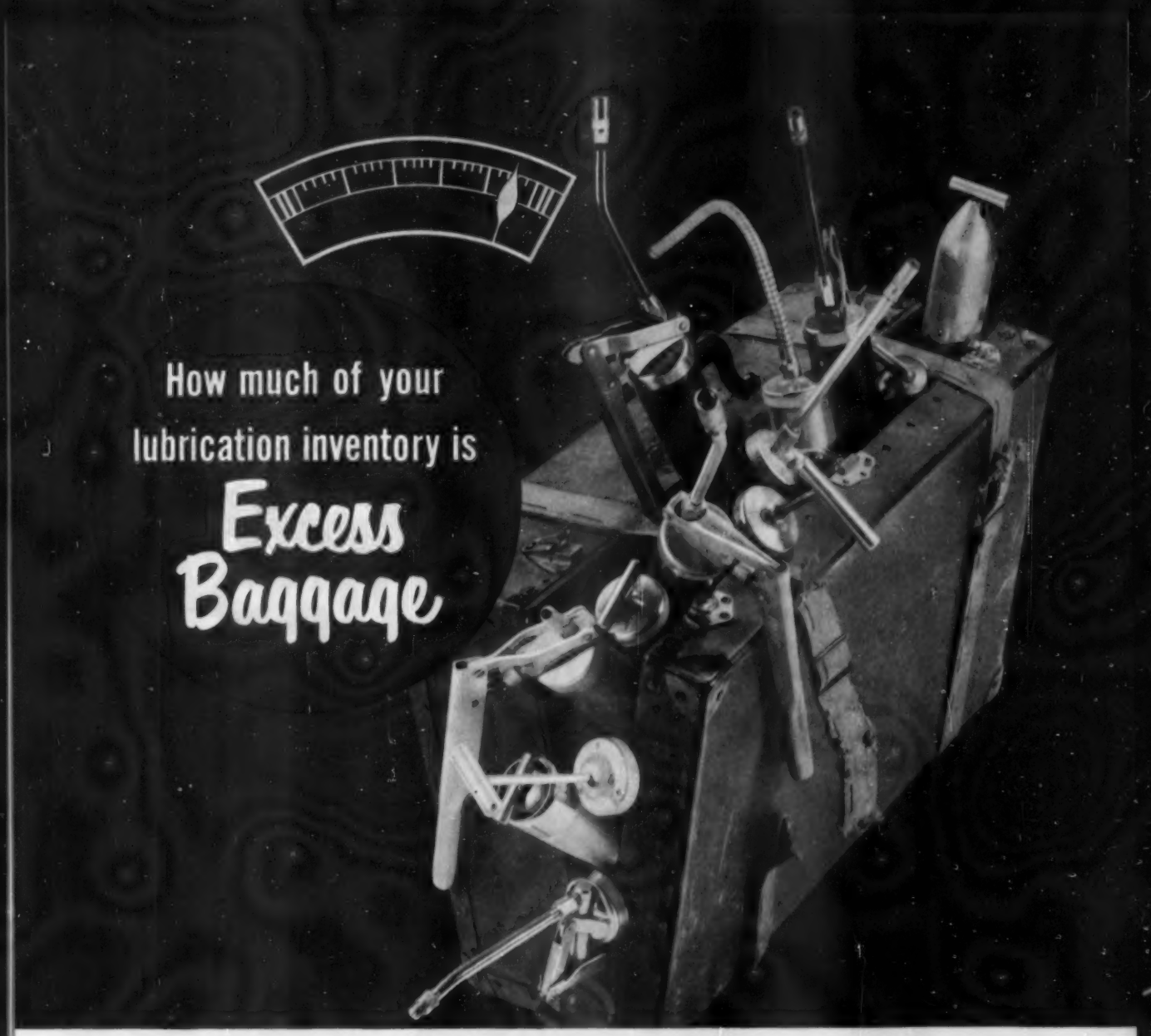
**PHILADELPHIA GEAR WORKS, INC.**

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
Virginia Gear & Machine Corp., Lynchburg, Va.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Established 1892

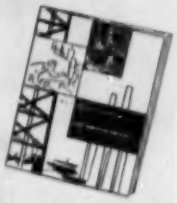



# Cut costs with Pure's "Simplify and Save" Plan

BE SURE
PURE
WITH PURE

If you're using more than 6 lubricants in your plant, chances are *Pure Oil's multi-purpose lubricants* can cut costs for you. Here's why: just 6 of these special lubricants are all you need—reduces your inventory . . . reduces chance for error in application (and resulting "down time") . . . and the fewer the man-hours needed for ordering, stocking and application.

Find out how Pure's multi-purpose lubricants can cut costs in your plant. Reverse the charges to your nearest Pure Oil office today.



FREE BOOKLET tells you "How to Simplify and Save." Write The Pure Oil Company, 35 E. Wacker Drive, Chicago 1, Illinois. (Offer limited to Pure Oil's 24-state marketing area.)

Be sure with Pure

**PURE MULTI-PURPOSE LUBRICANTS**

Sales offices located in more than 500 cities in Pure's marketing area

# THE BIGGEST

*Announcing*

# THE LQ600 VALVE

**ANOTHER LUNKENHEIMER "FIRST"**
**. . . the revolutionary new bronze valve which has broken all existing performance records!**

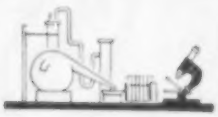
**LUNKENHEIMER THANKS ALL OF THE LEADING COMPANIES WHO COOPERATED IN THE FOUR-YEAR LQ600 FIELD TESTING PROGRAM**

The LQ600 Valve has been tested for four years in carefully chosen "problem installations" in American industry. *Despite the poor records of previous valves, there was not one single reported case of failure or leakage of an LQ600 Valve!* Here are a few typical records:

# LUNKEN

THE ONE *Great*

# BRONZE VALVE NEWS IN 50 YEARS!



This revolutionary bronze globe valve has set completely new performance standards in the most severe service in industry!

LQ600 gives you so much *more* service per dollar that you can't afford to continue using bronze globe valves that require constant repair and replacement!

Valve users, cooperating in a four-year testing program, were unable to find *any* service tough enough to wear out an LQ600 — or cause it to leak, even in the most severe throttling installations! This new valve is an investment — one that pays cash dividends in maintenance savings year after year!

BRINALLOY* SEATS AND DISCS make these remarkable performance records possible. This exclusive new Lunkenheimer alloy is far more resistant to wear and corrosion than 500 Brinell Stainless Steel — even outwears case hardened Stainless Steel exceeding 1000 Brinell! There is no need for renewability. *No LQ600 Valve in four years service has required maintenance.*

OTHER FEATURES — a streamlined new exterior . . . the famous Stemalloy® Stem, which far outlasts any other stem material . . . the cool, easy-to-grip Non-Slip® patented handwheel . . . durable, high-strength bronze in body and bonnet . . . and true back-seating, permitting safe and easy repacking under pressure.

*Patented alloy. Trade Mark, The Lunkenheimer Co.

*For more information, call your local Lunkenheimer Distributor or write The Lunkenheimer Company, Box 360, Cincinnati 14, Ohio.*

| TYPE OF SERVICE | LIFE OF OTHER VALVES | USER COMMENT |
|---|---|---|
| 125 lb. hose steaming | 2 wks. to 2 mos. | Toughest service, previous valves leaked. |
| Water col. blowdown | 2 mos. | Plug valves couldn't take it. |
| 185 lb. steam blowdown | 1 yr. | Plug valves failed every year. |
| 125 lb. steam blowdown | "Short" | Previous valve leaked every run. |
| 200 lb. steam—water col. blowdown | 2 mos. | Previous valves failed by wiredrawing. |
| Throttling syrup 140°F. | "Short" | Previous valves cut. |
| 150 lb. throttling 380°F. | 6 mos. | Plug valves failed regularly. |
| 100 lb. throttling | 2 wks. to several mos. | Plug valves couldn't hold up. |
| 130 lb. throttling | 8 mos. | Composition seat valves unsatisfactory. |
| 110 lb. throttling steam | 3 wks. to 3 mos. | Three other kinds failed. |
| Scaled hot water line | "Short" | About all makes used—none held up. |
| 125 lb. throttling steam | 6 to 12 mos. | Plug valves failed by wiredrawing. |
| 150 lb. steam—scale present | "Short" | Previous valves broke. |
| 150 lb. throttling steam | 4 to 5 mos. | Other makes failed by wiredrawing. |

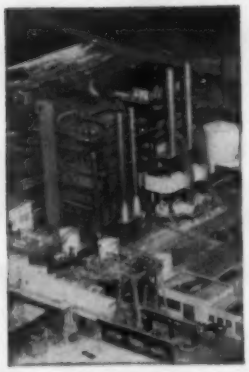
LQ600
150 LB. S.P.
300 LB. W.O.G.

# HEIMER®

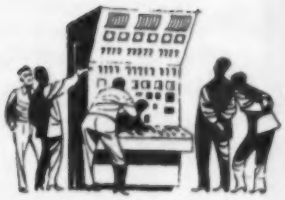
NAME IN VALVES

BRONZE • IRON
STEEL • PVC

L-455-4



*Louisiana Power & Light Company's third unit at Ninemile Point Plant designed by Ebasco Services, Incorporated with Instrumentation and Control by Hays.*



MORE AND MORE **CENTRAL STATIONS** ARE SELECTING **HAYS** INSTRUMENTS AND CONTROL

# New ideas in instrumentation and control featured in outdoor boiler plant

MEET DEMANDS OF LATEST TYPE BOILER IN SPACE SAVING, GREATER SPEED OF RESPONSE, ALTERNATE FUEL FIRING.

Practically every detail of the third unit of Louisiana Power's new Ninemile Point generating plant is of the newest design. An all-weather outdoor boiler with Hays electric type combustion control—gas fired, with provisions for "stand-by" oil firing—will produce 1,000,000 lbs. of steam per hour, superheated and reheated to 1,005° F. . . . adding a capability of another 135,000 KW to Louisiana's power program.

On outdoor boilers electrically operated combustion control is especially preferred because it doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

To answer operators' demands for more instruments in less space, Louisiana Power is installing a miniature remote control station. This Hays benchboard, which is four feet wide contains all important remote control elements—manual adjustments for the boiler, turbine and generator.

For faster speed of response and greater accuracy a number of Hays electronic instruments are being installed. Among these are—electronic mercury-less flow meters and 3 element electronic feedwater control.

Among the central stations recently selecting Hays instrumentation and control are: Jersey Central Power and Light Co., Northern Indiana Public Service Co., Central Illinois Electric and Gas Co., St. Joseph Power and Light Co., Crawfordsville Power and Light Co.

*Write for Hays Boiler Plant Instrumentation Bulletin 54-605-83.*

THE **hays** CORPORATION

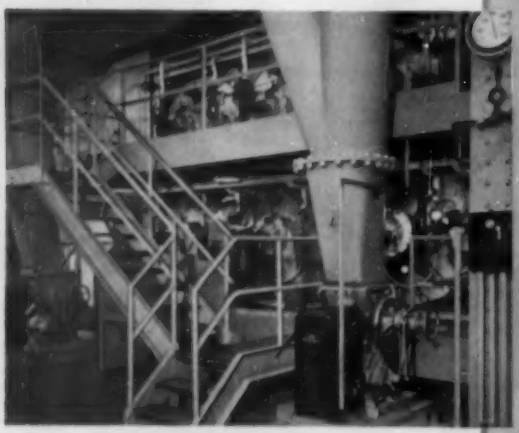
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • $CO_2$ Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

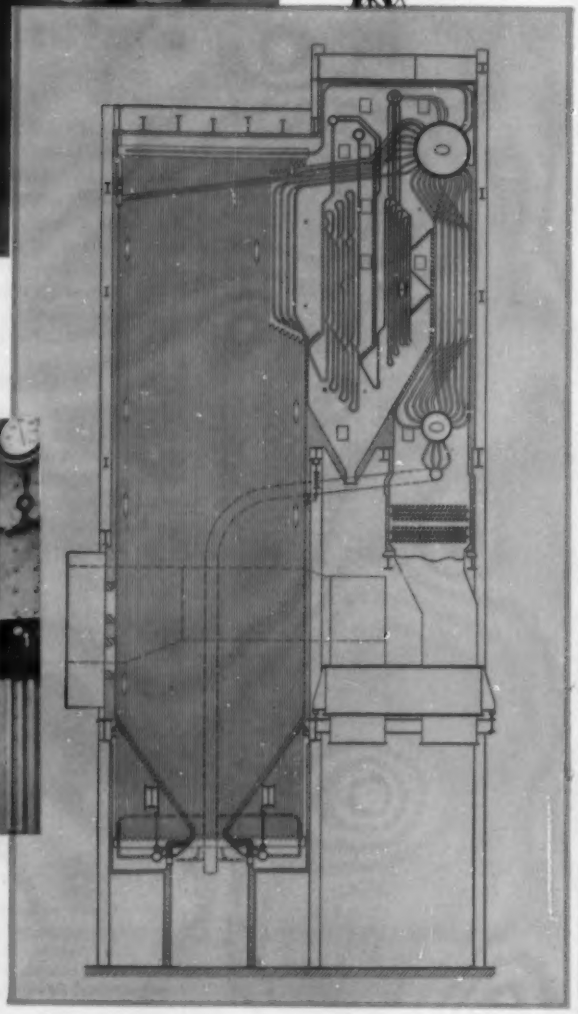
# SCHILLER STATION

## *helps meet rising*

Looking east toward Schiller Station and the Piscataqua River. Addition housing FW steam generator now being erected on the right of the present structure. Consulting Engineers: Jackson & Moreland, Boston, Mass.



View showing oil burners serving Foster Wheeler boiler. Fuel consumption 65 gallons of oil per minute.



Cross-section of one of two identical Foster-Wheeler 2-drum steam generators at Schiller Station, Portsmouth, N. H. Design pressure 1475 psig; final steam temperature 950F peak capacity 450,000 lbs per hr.

*demand for electric service in New Hampshire*

**Foster Wheeler 450,000 lb per hr steam generator, installed in Schiller Station of Public Service Company of New Hampshire, has augmented station's capability by over 50,000 kilowatts. A second Foster Wheeler unit, now under construction, will contribute an additional 50,000 kilowatts to the rapidly growing power-producing facilities of this business-managed utility.**

*Reddy Kilowatt*

SCHILLER STATION of Public Service Company of New Hampshire was first opened in 1950. But, to meet the ever-growing demand of New Hampshire's thriving industries, farms and homes, in the four short years that have passed, Public Service has found it necessary, upon two occasions, to increase the power-producing facilities of this station.

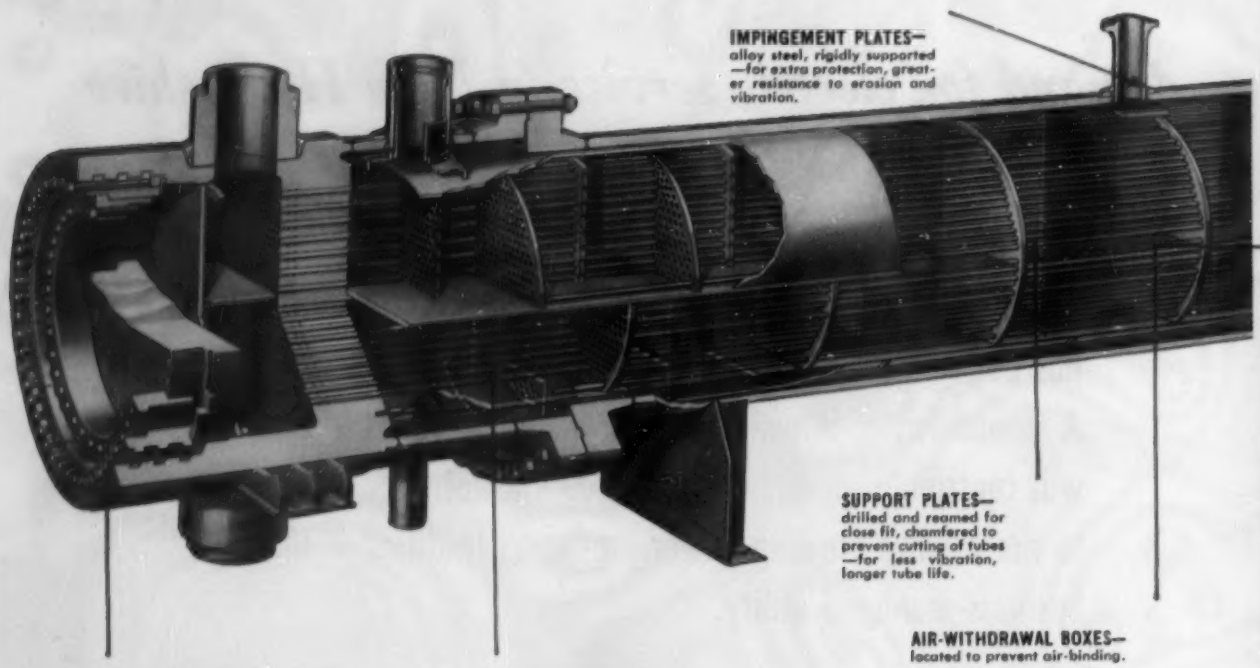
In the first addition, a two-drum Foster Wheeler steam generator — complete with superheater, economizer and waterwalls as shown in the accompanying cross-section — was installed. This added 50,000 kilowatts to the station's capability. For the second addition, now being constructed, an identical Foster Wheeler steam generator is specified that will contribute an added 50,000 kilowatts.

This installation is another example of Foster Wheeler's ability to design and construct equipment to meet exacting power-producing needs — equipment that reflects the engineering ingenuity of an organization long recognized as a pioneer in the field of steam generation. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

**Trade mark character used by permission of Reddy Kilowatt, Inc.*

FOSTER WHEELER

# *For Modern Power Plants...*


IMPINGEMENT PLATES—
alloy steel, rigidly supported —for extra protection, greater resistance to erosion and vibration.
SUPPORT PLATES—
drilled and reamed for close fit, chamfered to prevent cutting of tubes —for less vibration, longer tube life.
AIR-WITHDRAWAL BOXES—
located to prevent air-binding.
SMALLER SCREW FASTENINGS—
to set in water box closure.
LARGE ESCAPE AREA—
plus excellent steam distribution—for increased operating efficiency.

# HIGH-CAPACITY HEAT TRANSFER

## ALCO'S New . . . Improved Feedwater Heater . . . and Flex-Tube Evaporator

Together they mean new efficiency and performance . . . greater savings for you.

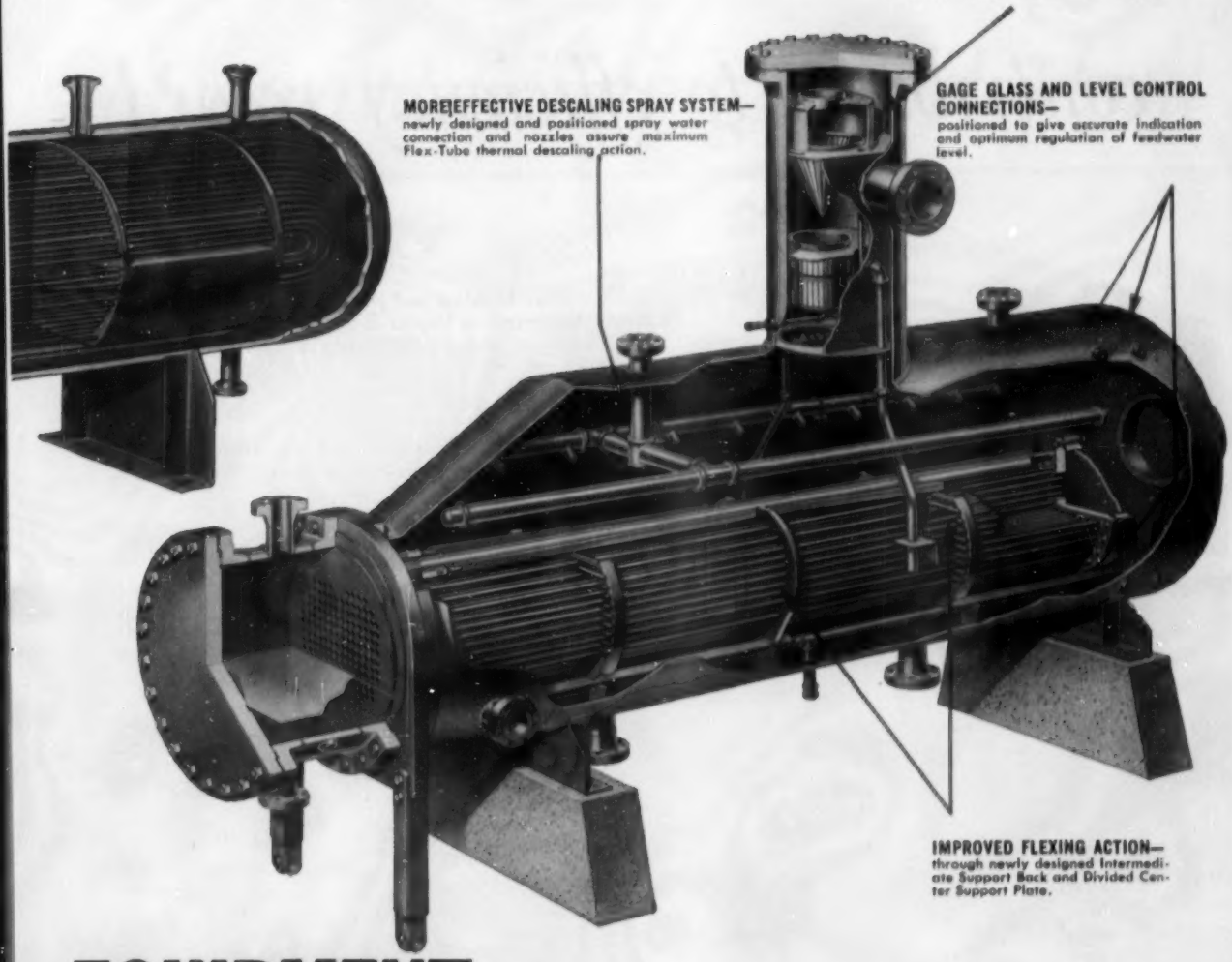
Listed are but a few of the many new operating and installation advantages you get when you specify either or both of these dependable ALCO items.

ALCO Feedwater Heaters and Flex-Tube Evaporators are built to ASME Code specifications. They're custom-engineered to meet your individual requirements and backed by ALCO's more than 25 years experience in supplying equipment for over 100 power installations across the nation. Call your ALCO representative for full particulars about these units or about specialized equipment for atomic energy installations—you also may write to Box 1065, Schenectady, New York.

**SUPERIOR VAPOR SEPARATOR SYSTEM—** made possible through a new 3-stage dryer, scrubber and purifier assembly.

**MORE EFFECTIVE DESCALING SPRAY SYSTEM—** newly designed and positioned spray water connection and nozzles assure maximum Flex-Tube thermal descaling action.

**GAGE GLASS AND LEVEL CONTROL CONNECTIONS—** positioned to give accurate indication and optimum regulation of feedwater level.



**IMPROVED FLEXING ACTION—** through newly designed Intermediate Support Sock and Divided Center Support Plate.

# EQUIPMENT

**Consult your ALCO Sales and Engineering Representative:**

| | |
|---|---|
| ATLANTA, Ga. | 490 Glenn St., S. W. |
| BEAUMONT, Tex. | 1400 Crockett Street |
| CHICAGO, Ill. | 909 McCormick Bldg. |
| CLEVELAND, Ohio | Terminal Tower Bldg. |
| HOUSTON, Tex. | 1404 Dunlavy Street |
| KANSAS CITY, Mo. | 606 Commerce Trust Bldg. |
| LOS ANGELES, Calif. | 2500 West 6th Street |
| NEW YORK, N. Y. | 30 Church Street |
| PITTSBURGH, Pa. | 527 Frick Building |
| ST. LOUIS, Mo. | 4050 Bingham Avenue |
| ST. PAUL, Minn. | 635 Prior Ave. N. |
| SAN FRANCISCO, Calif. | 235 Montgomery St. |
| TULSA, Okla. | 200-206 North Denver St. |
| WASHINGTON, D. C. | 910 17th Street, N. W. |

**ALCO PRODUCTS**

**ALCO PRODUCTS, INCORPORATED**

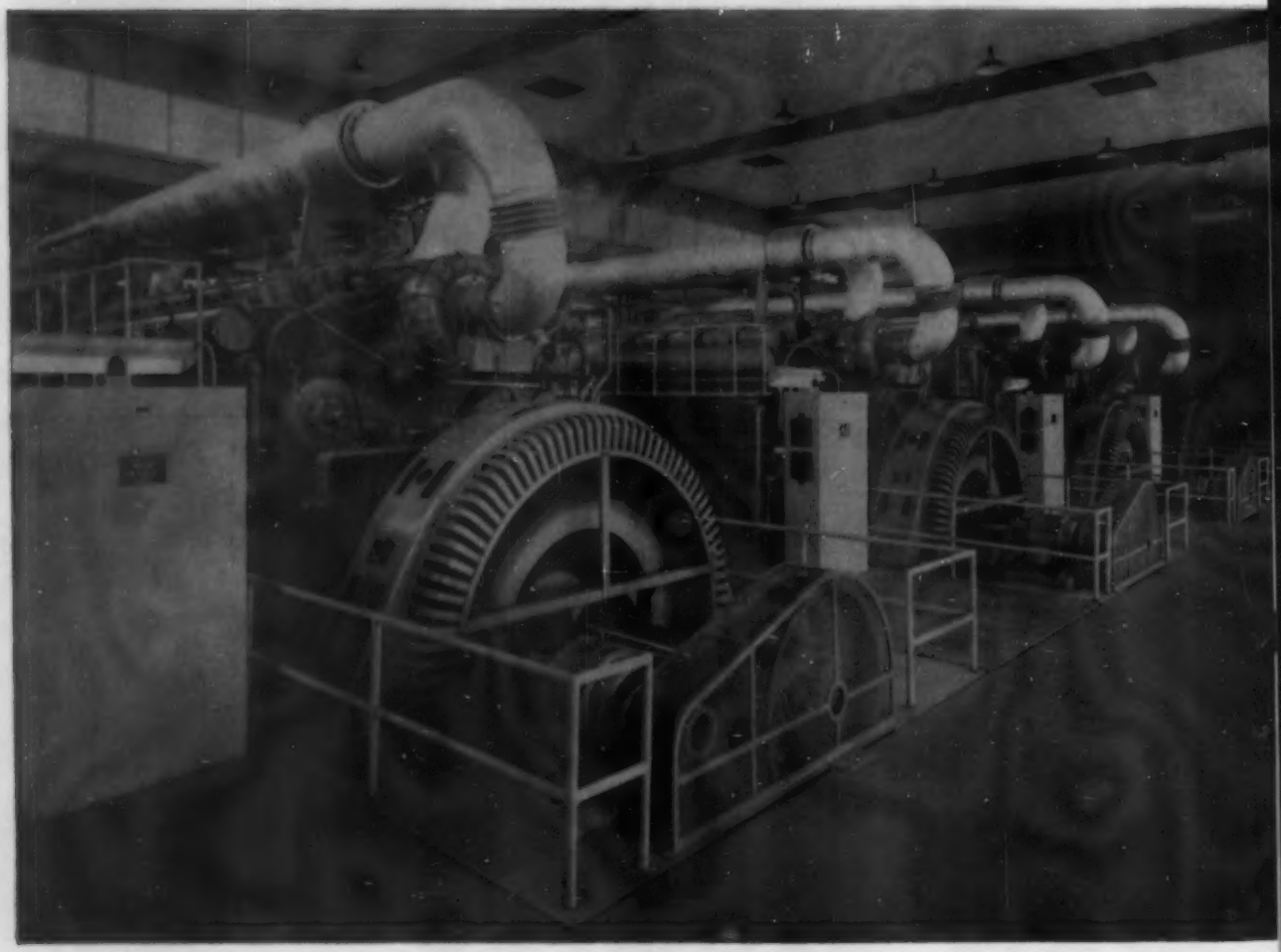
*formerly* AMERICAN LOCOMOTIVE COMPANY

# Gulf Dieselmotive

## *contributes to efficiency record*

Modern office building and plant of the M & A Electric Power Cooperative, Poplar Bluff, Missouri, winner of the 1954 Diesel Progress Efficiency Award.

Gulf Dieselmotive Oil provides the vital lubrication for these four Cooper-Bessemer 16-cylinder Diesels in the M & A Plant.



# Oil

## *at award-winning Diesel plant*

The M & A Electric Power Cooperative of Poplar Bluff, Missouri, has been named winner of the 1954 Diesel Progress award for the most efficiently operated REA internal combustion plant.

Gulf Dieselmotive Oil provides the kind of lubrication necessary for such an award-winning performance! This modern Diesel lubricant protects the four Cooper-Bessemer 16-cylinder Diesel engines in the M & A Plant against excessive wear, and contributes to efficient operation and lower maintenance costs.

*Here's why:*

1. Effective detergent action prevents harmful piston ring belt deposits.
2. Base stocks are selected for their ability to help prevent hard deposits on the piston crown and in the ring belt area.
3. 100% solvent refining (removing undesirable constituents) insures greater stability and better bearing protection.

Investigate the operating savings possible with Gulf Dieselmotive Oil in your Diesels. Contact your nearest Gulf office today and have a Gulf Sales Engineer recommend the proper grade.

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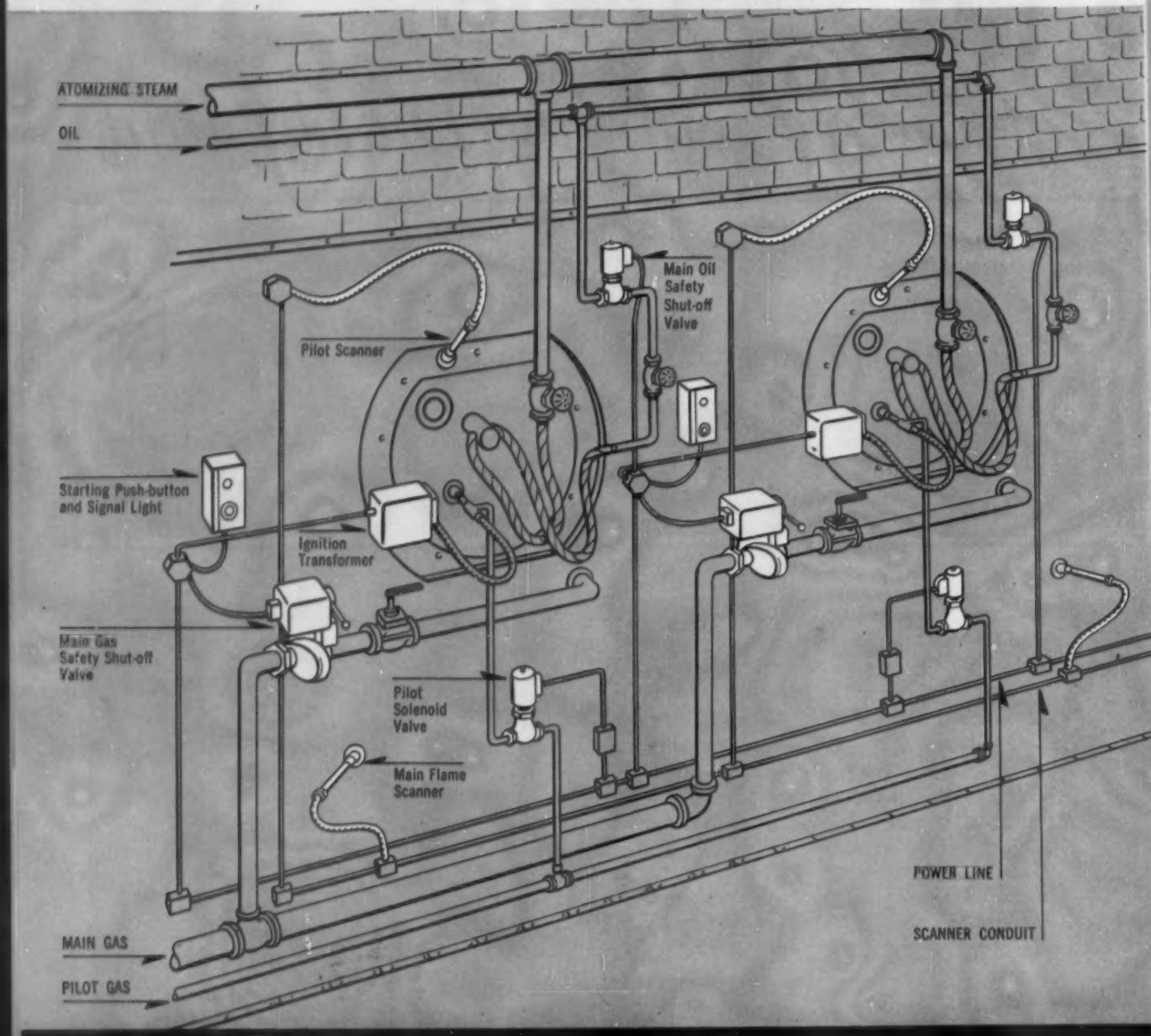
1822 Gulf Building, Pittsburgh 30, Pa.

GULF

**THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS**

# NOW, A Really Safe Way to




**fireye Interlock System offers you all these safeguards in a single**

Alarm Horn

Starting Switch and Pilot Light

Ignition Transformer

Pilot Solenoid Valve

SCANNER ASSEMBLY

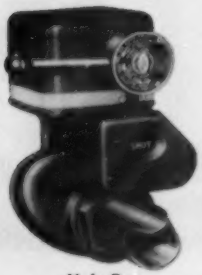
Swivel Mount

Sealing Union

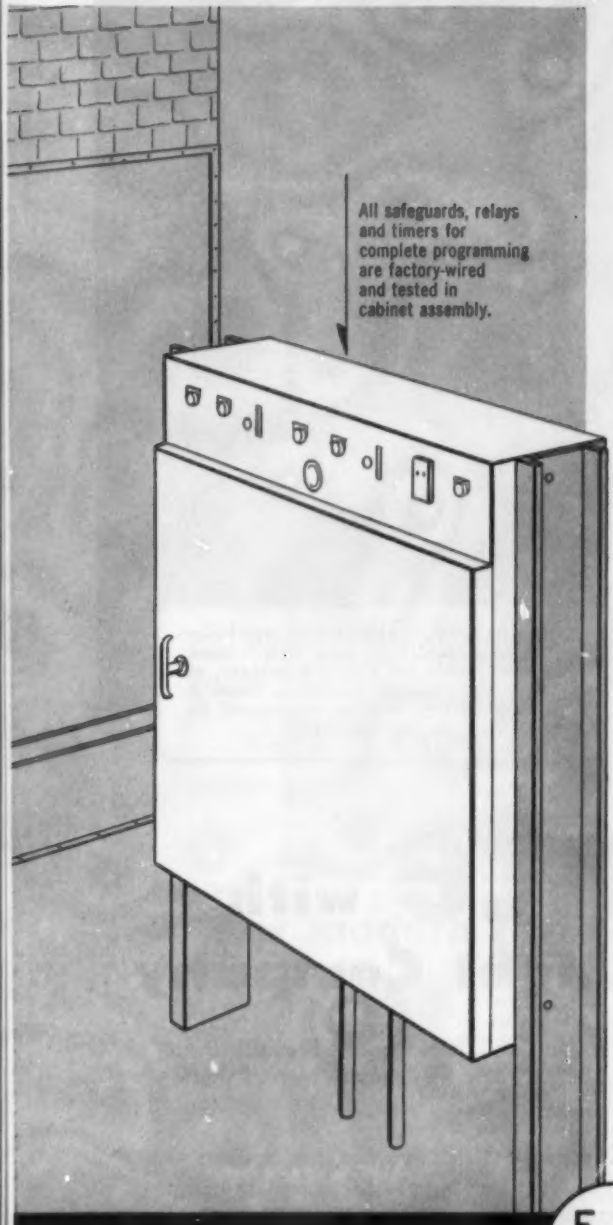
Insulating Tube

Electronic Scanner

Main Oil Safety Shutoff Valve


Main Gas Safety Shutoff Valve

# Operate Your Power Boiler




"package"

Complete Cabinet Assembly

## New Fireye "Packaged" Interlock System automatically insures safe light-off and firing.

Now, for the first time, you can have a complete "packaged" safeguarding system for your power boiler. This single factory-integrated control system automatically, positively enforces a safe light-off procedure and supervises the flame during firing.

Every stage of lighting-off each burner is precisely controlled by Fireye's system of timers, interlocks, and shutoff valves. And, if the flame goes out, the system shuts off fuel in 2 to 4 seconds . . . and will not allow re-ignition before the combustion chamber is completely purged.

This new Fireye system eliminates the hazards of incorrect light-off and flame failure, which insurance records show are the cause of 85% of all furnace explosions. It can be installed on any multiple burner boiler. Installation supervision by a qualified Fireye engineer is part of our national service, when desired.

For full details, call your local Fireye representative, or use the coupon below.

**COMBUSTION CONTROL DIVISION**
**ELECTRONICS CORPORATION OF AMERICA**
718 Beacon St., Boston, Mass.

ECA

fireye

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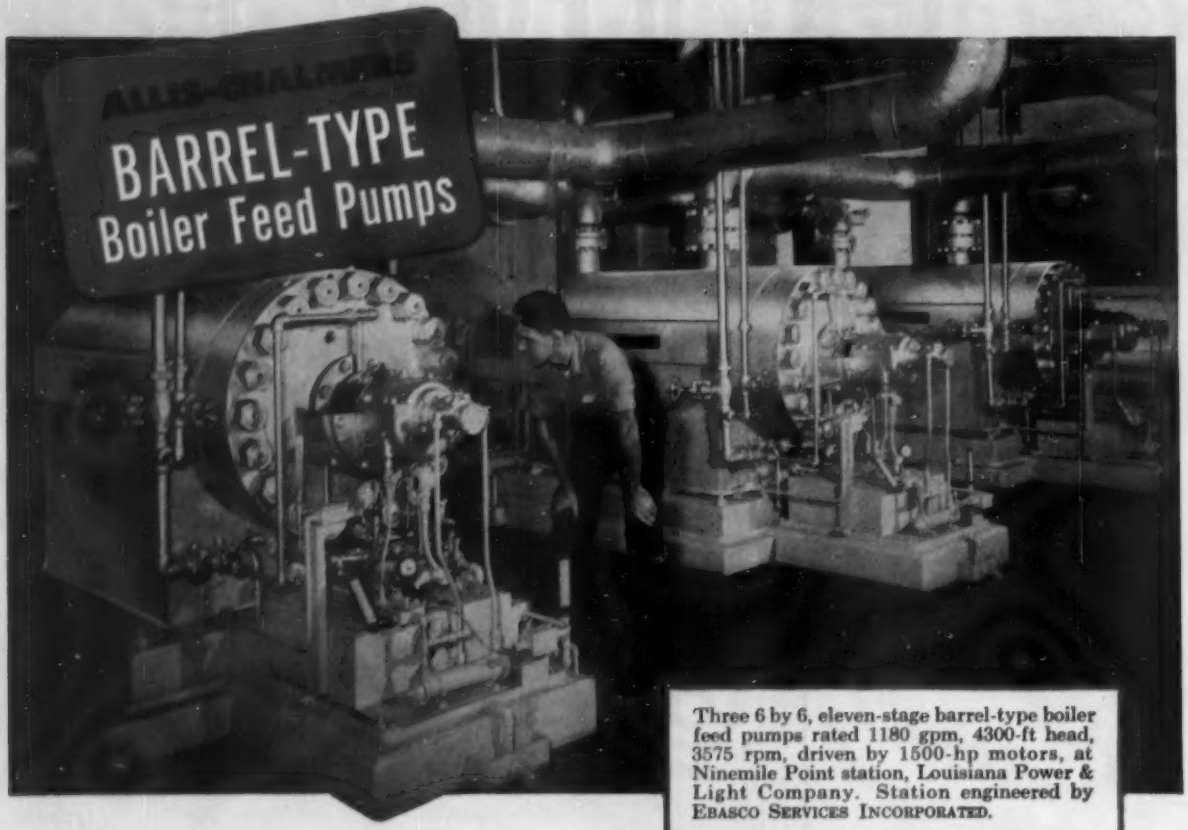
**Electronics Corporation of America, Dept. C9-5,**
**718 Beacon Street, Boston 15, Massachusetts**

Please send me your new bulletin describing safe start-up and firing practices for multiple burner boilers.

NAME _____

COMPANY _____

STREET _____ CITY _____




Three 6 by 6, eleven-stage barrel-type boiler feed pumps rated 1180 gpm, 4300-ft head, 3575 rpm, driven by 1500-hp motors, at Ninemile Point station, Louisiana Power & Light Company. Station engineered by EBASCO SERVICES INCORPORATED.

# First Choice with Louisiana Power & Light Company

**A proved service record** the country over . . . simple, low maintenance design . . . high efficiency performance — these were some of the factors that led Louisiana Power & Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their Ninemile Point station.

### Features Keep Operating Costs Low

First stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers, mounted back to back, balance axial forces without use of balancing drum. Double volute casing maintains radial balance under fluctuating load. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

### Complete Unit From One Source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 08B7899.

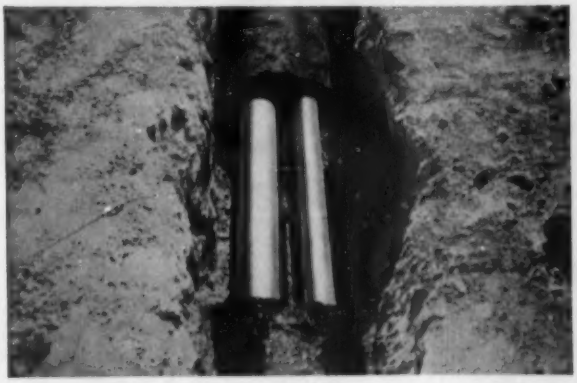
A-4635

ALLIS-CHALMERS

# 3 Big Reasons Why

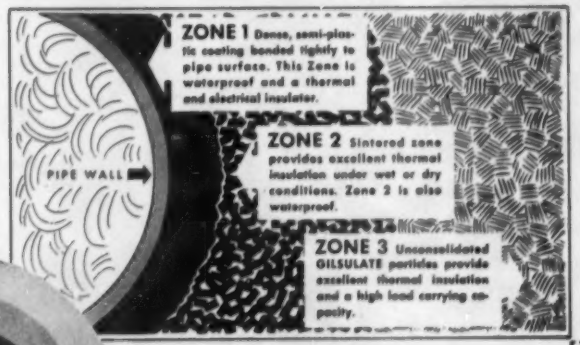
**1. GILSULATE—Easy to install**—Just pour it on, tamp it down and backfill. Run heat through the pipes (up to 520°F)...and the job is completed. No need to remove rocks from backfill; no problems of cramped space or multiple piping.

## more and more hot underground pipe gets insulated



**2. GILSULATE—Cost Less per Installed Linear Foot**—No skilled labor needed...requires no mechanical sheaths, special protective devices, or costly installation procedures.

## with new modern triple-zone GILSULATE®


ZONE 1 Dense, semi-plastic coating bonded tightly to pipe surface. This Zone is waterproof and a thermal and electrical insulator.
ZONE 2 Sintered zone provides excellent thermal insulation under wet or dry conditions. Zone 2 is also waterproof.
ZONE 3 Unconsolidated GILSULATE particles provide excellent thermal insulation and a high load carrying capacity.
PIPE WALL

**3. GILSULATE—Delivers Permanent Triple-Zone Protection**—Three tough, massive circular sheaths completely and permanently protect the pipe, cut heat loss down to 8% to 11% of bare buried pipe. Triple-zone protects against all buried line corrosion conditions: water, roots, acid, alkalis, bacteria, etc.

*Fill in coupon for complete details.*

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES

**AMERICAN GILSONITE COMPANY, SALT LAKE CITY, UTAH**
*Affiliate of Barber Oil Corporation and Standard Oil Company of California*
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Salt Lake City, Utah

Please send me further information on GILSULATE

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TITLE.....

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P

# What's your angle?

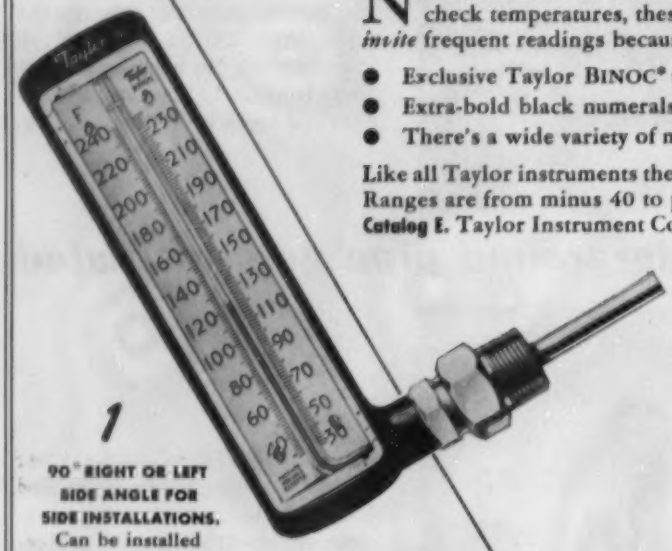
NO MATTER how awkward the angle from which your operators have to check temperatures, these easy-reading Taylor Industrial Thermometers *invite* frequent readings because—

- Exclusive Taylor BINOC* tube is three times easier to read.
- Extra-bold black numerals stand out sharply on white background.
- There's a wide variety of mounting angles, stems and connections.

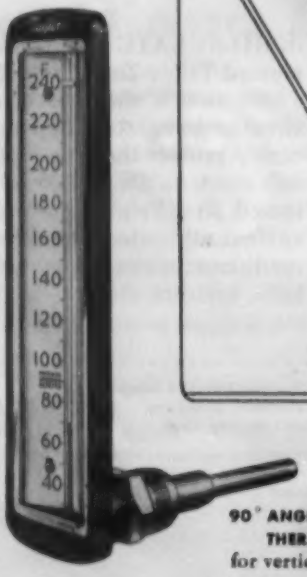
Like all Taylor instruments they're built to give you years of dependable service. Ranges are from minus 40 to plus 950° F. or equivalent Centigrade. Write for **Catalog E.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

*Reg. U.S. Pat. Off.

## Taylor Instruments
**MEAN ACCURACY FIRST**

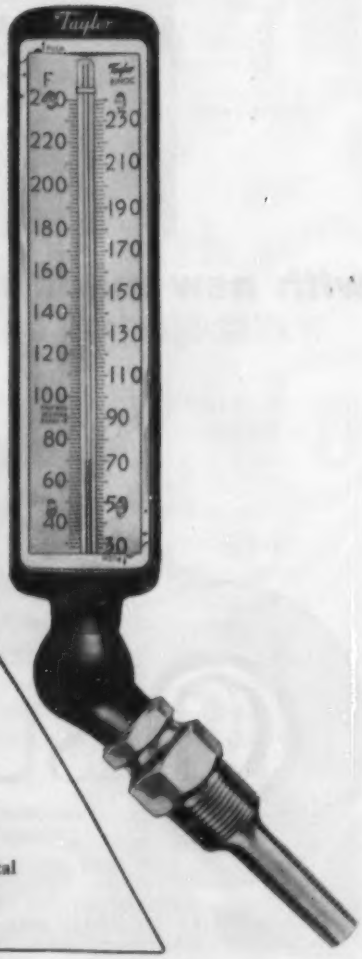


**1**
**90° RIGHT OR LEFT SIDE ANGLE FOR SIDE INSTALLATIONS.**
Can be installed forward or backward for eye level reading.



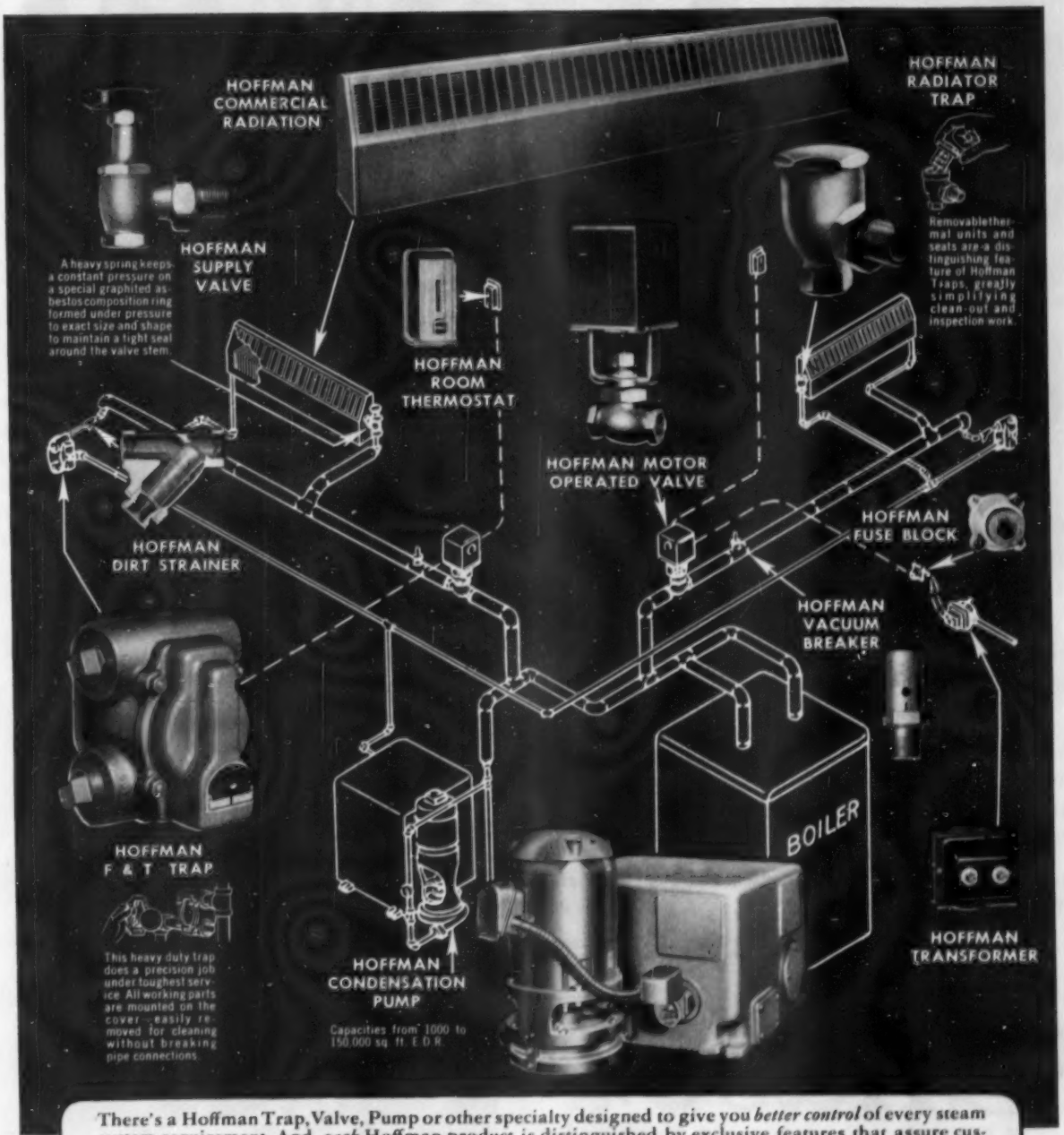
**2**
**90° ANGLE INDUSTRIAL THERMOMETER**
for vertical pipe lines.

**3**
**STRAIGHT INDUSTRIAL THERMOMETER**
for inserting on horizontal pipe lines.



**4**
**135° OBLIQUE RIGHT OR LEFT SIDE ANGLE**
for difficult locations.

# HOFFMAN COMPLETE LINE OF *STEAM SYSTEM CONTROLS*


HOFFMAN COMMERCIAL RADIATION
HOFFMAN RADIATOR TRAP
A heavy spring keeps a constant pressure on a special graphited asbestos composition ring formed under pressure to exact size and shape to maintain a tight seal around the valve stem.
HOFFMAN SUPPLY VALVE
Removable thermal units and seats are a distinguishing feature of Hoffman Traps, greatly simplifying clean-out and inspection work.
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HOFFMAN MOTOR OPERATED VALVE
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BOILER
HOFFMAN F & T TRAP
This heavy duty trap does a precision job under toughest service. All working parts are mounted on the cover—easily removed for cleaning without breaking pipe connections.
HOFFMAN CONDENSATION PUMP
Capacities from 1000 to 150,000 sq. ft. E.D.R.
HOFFMAN TRANSFORMER

There's a Hoffman Trap, Valve, Pump or other specialty designed to give you *better control* of every steam system requirement. And, *each* Hoffman product is distinguished by exclusive features that assure customer satisfaction, long, care-free service. *It's the* COMPLETE, *tested, quality line* backed by a dependable, single source of supply and responsibility. *Yet Hoffman Products cost no more than the ordinary kind—and pay their way with the fuel they save.* To avoid delays—order now from your wholesaler of heating and plumbing supplies. Catalogs available on all items.

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Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensate Pumps. Sold by Leading Wholesalers of Heating and Plumbing Equipment

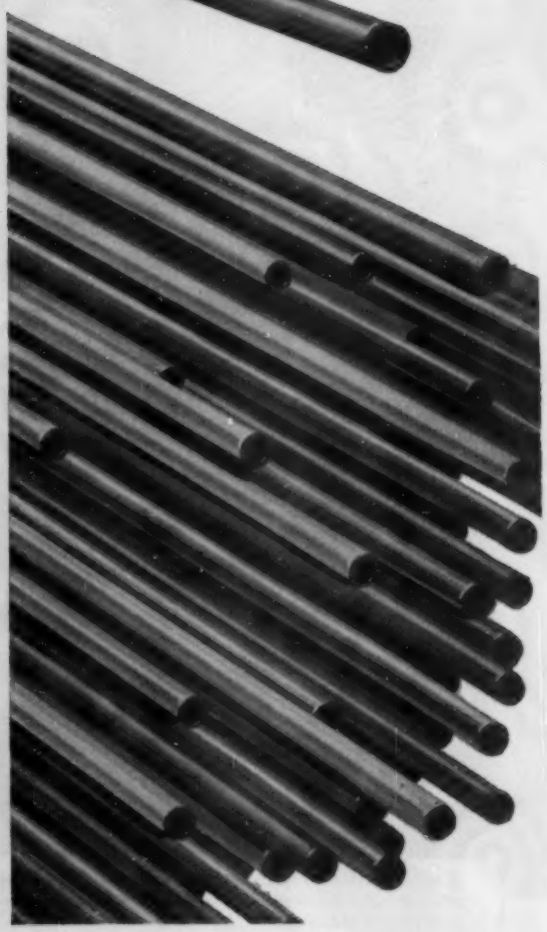
## CHASE® ANTIMONIAL ADMIRALTY
# CONDENSER TUBES
## RESIST DEZINCIFICATION!

Chase Antimonial Admiralty Condenser Tubes give *extra* years of service, because they contain the *right* amount of antimony needed to resist dezincification!

And Chase Antimonial Admiralty stands up through years of heavy stresses in the field, because antimony is one inhibitor that will *not* weaken tube strength!

Since 1935, Chase Antimonial Admiralty has added years of life to thousands of condenser tube installations. When replacing condenser tubes, or planning new installations, insist on Chase Antimonial Admiralty.

For more information on Chase Antimonial Admiralty, send for the free Chase Condenser and Heat Exchanger Tube Booklet.



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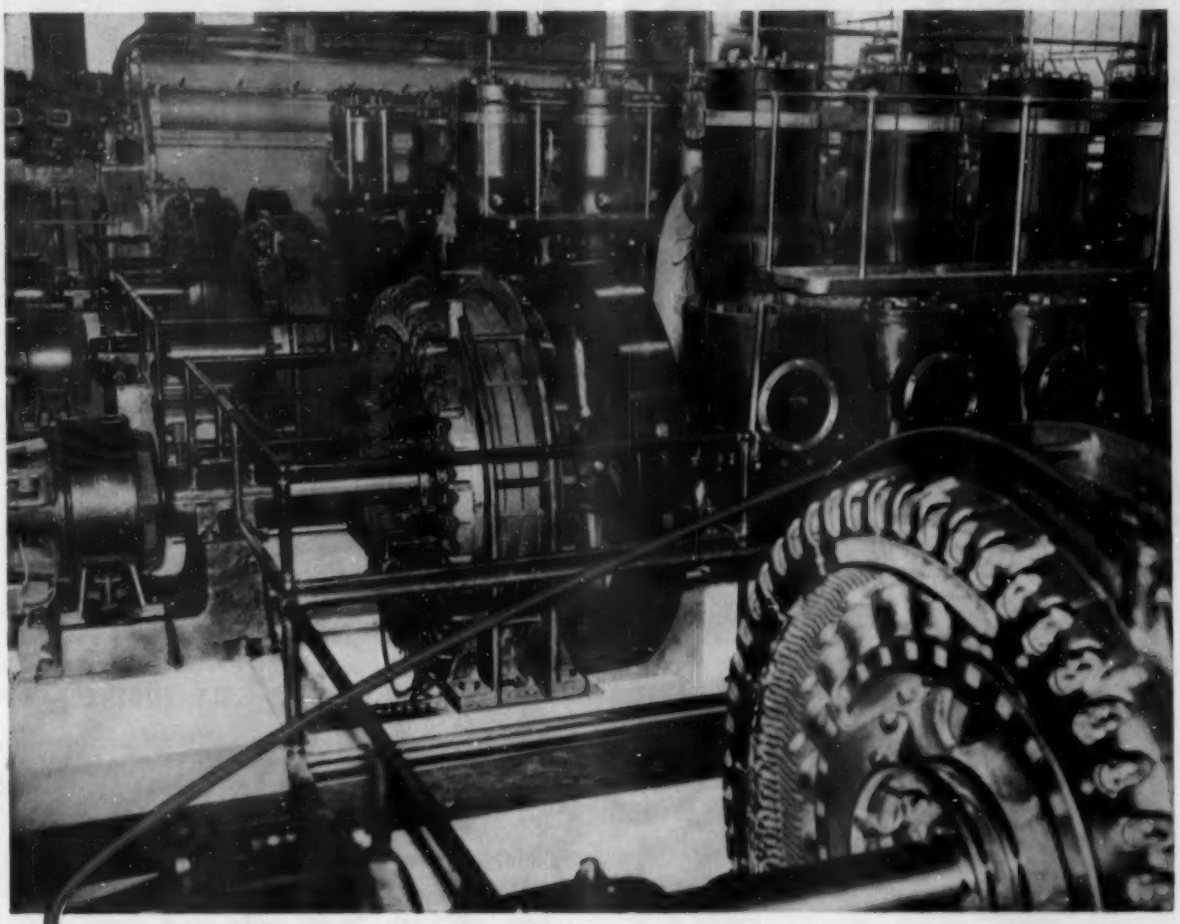
# Resists Wear!



Switch now to Sinclair GASCON® Oils for top anti-wear lubrication and longer engine life in your diesel engines.

Actual performance results prove that the superior GASCON Oils eliminate stuck piston rings, reduce carbon deposits on vital engine parts, cut cylinder wear to a minimum . . . and improve the ratio of KW-HRS. per GALLON of Lubricating Oil.

Sinclair GASCON and GASCON H.D. Oils *can save you money* by assuring longer bearing life . . . higher productivity . . . lower operating costs.

See your Sinclair Representative today for further information or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

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**GASCON OILS**

# HOW TO BUY CONVEYOR BELTS

**and get...**
***MORE USE PER DOLLAR***
**where**
**SPECIAL ENGINEERING**
**is needed**

Look for a make of belt backed by experienced, specialized engineering service.

Selecting the right conveyor belt to solve a special problem begins with selecting the right representative . . . one who will take interest in your particular belt needs and refer your problems to his factory if engineering help is required. Where a company makes a wide selection of conveyor belts for many applications, the representative can often recommend a feature construction to meet your job requirements. Where your problem is unique, that company backs its field men with custom engineering and comes up with a recommendation to meet your specific operating conditions.

Choose the company that offers *complete* belt engineering service . . . the source of supply that maintains close contact between factory and field.

## RAYBESTOS-MANHATTAN CONVEYOR BELT ENGINEERING

A leading steel mill, faced with handling hot sintered ore without an insulating layer of "fines", had numerous belt failures due to charring.

An R/M representative called in a factory engineer. A new custom-engineered R/M conveyor belt with special cover now saves hundreds of dollars a year at the mill.

and . . . where hot ash and clinker was wearing out a conveyor belt every month at a Michigan cement plant, an R/M field man was able to furnish a specially engineered Homocord Belt which has outlived the best previous belt four times over.

and . . . special, "chevron cleated" conveyor belt was developed by R/M, as a result of a field representative request, to replace a smooth surfaced belt unable to carry wet iron ore up a mine slope without costly spillage.

These are just a few of many instances where R/M engineering service has solved conveyor belt problems. In other cases, special job requirements have been met with R/M's exclusive constructions such as extra-flexible Ray-Man "F" . . . extra-cushioned Homocord for shock-loading . . . and Ray-Man Tension-Master for extra-high tensions and long lifts.

Let an R/M representative show you why R/M engineering makes R/M Conveyor Belts last much longer . . . give you "More Use per Dollar".

RM-102-A50

RM

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

**RAYBESTOS-MANHATTAN, INC.**

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

## Improve Heat Transfer ...Reduce Maintenance

# by Eliminating Corrosion

**Even when an efficient deaerator** removes free carbon dioxide from your system, additional $CO_2$ produced by decomposition of bicarbonates and carbonates remains to cause return line corrosion. Residual oxygen causes pitting. Protecting against both $CO_2$ and $O_2$ considerably reduces the cost of replacing and maintaining steam and return lines. Keeping the system free of corrosion products assures high heat transfer efficiency.

One series of Allis-Chalmers corrosion inhibitors solves this problem by neutralization. These materials are blends of the most effective amines, selected according to the volatility characteristics required by each steam condensate system. Protection is provided against both $CO_2$ and $O_2$ at the points where it is needed.

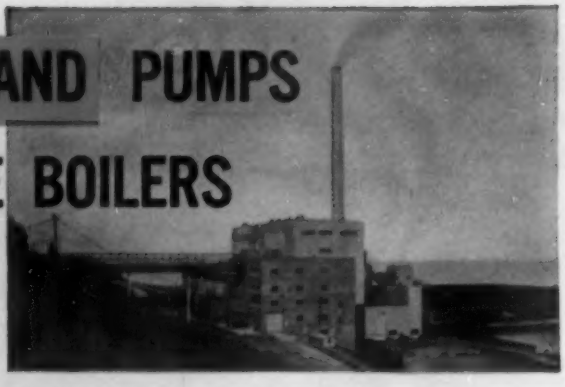
Although recommendations for your specific needs can be made only after thorough analysis, you can get more information about use of this series by obtaining a copy of Allis-Chalmers Water Conditioning Informational Bulletin 50. Get a copy from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

# ALLIS-CHALMERS

**Water Conditioning—Chemicals, Equipment, Service—for more than 25 years**

A-6606

# 10-STAGE INGERSOLL-RAND PUMPS SUPPLY HIGH PRESSURE BOILERS AT OAK CREEK

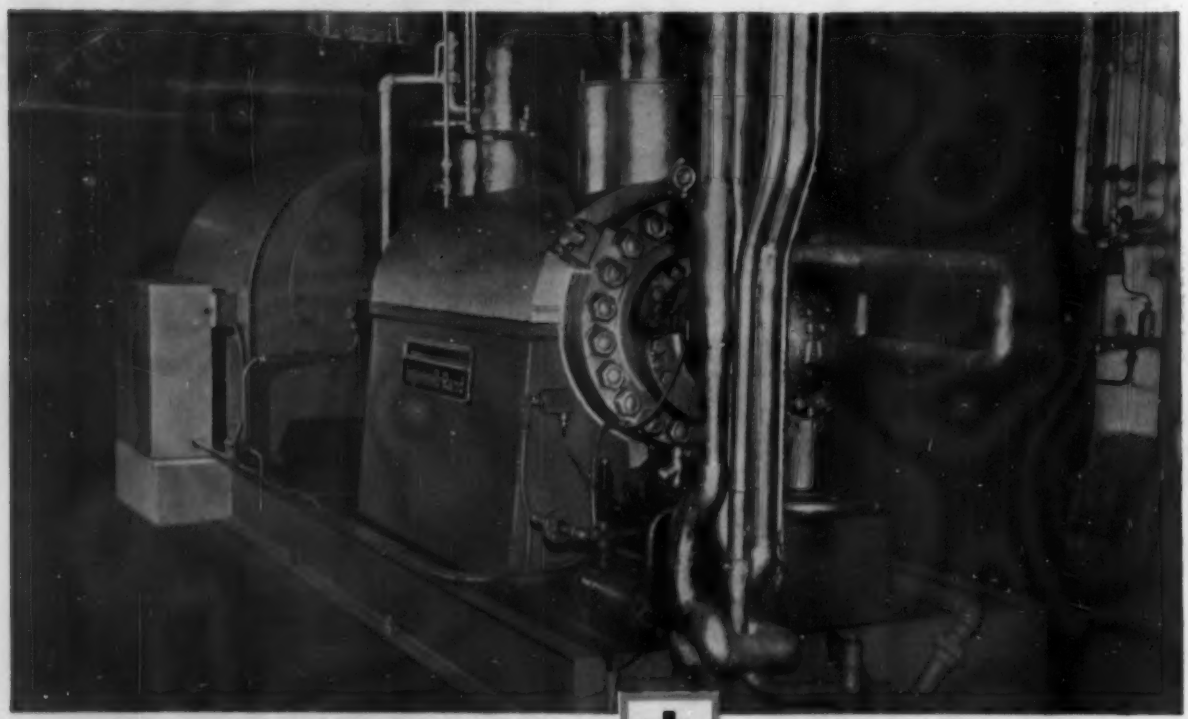


*Double-Case Boiler-Feed Pumps give dependable service at Wisconsin Electric Company's New Oak Creek Station*

Though still growing, the Oak Creek Station of Wisconsin Electric Company has had 120,000 kw Unit No. 1 on the line for a year. And Unit No. 2 will soon be put in operation, bringing total plant capacity to 240,000 kw. Two additional units of the same capacity are yet to be installed.

The Ingersoll-Rand CHTA pumps supplying feedwater to the controlled-circulation boilers have had a chance to prove their performance on the job. Four of these huge 10-stage double-case pumps are now installed — a pair for each 120,000 kw generating unit. Pumps are rated 425,000 lb./hr. each at a pressure of 1900 psi.

For *proved performance* at *high pressures*, it pays to specify I-R boiler feed pumps. Your Ingersoll-Rand pump specialist will be glad to help you plan your next installation.



**Ingersoll-Rand**

Cameron Pump Division
11 Broadway, New York 4, N. Y.

An Ingersoll-Rand 10-stage Class CHTA pump serving Unit No. 1 at Oak Creek Station.

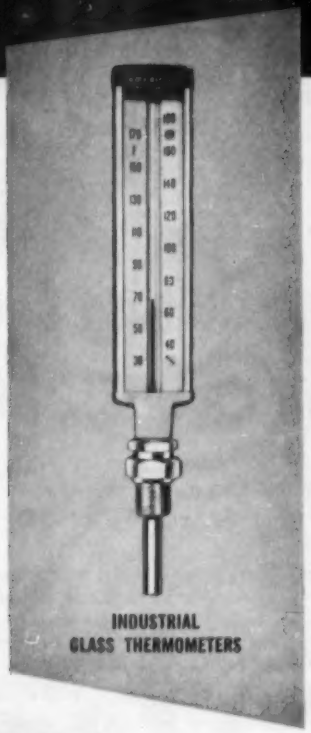
10-81

PUMPS • COMPRESSORS • VACUUM EQUIPMENT • GAS & DIESEL ENGINES • AIR & ELECTRIC TOOLS • ROCK DRILLS

DIAL THERMOMETERS

RECORDING THERMOMETERS

# GET SERVICE-PROVED ECONOMY



INDUSTRIAL GLASS THERMOMETERS

## SPECIFY AMERICAN THERMOMETERS!

Is exact temperature measurement essential to safeguard your equipment? To assure uninterrupted service to customers? To maintain product quality? To control costs? Then American Thermometers belong in your plant! They are an unbeatable combination of highest quality materials, advanced design, rugged construction and precision manufacture. Their sustained accuracy protects processes, products and profits. Their long-life durability has been proved in outstanding performance in the severest services.

Whether you need industrial glass thermometers, dial types, or recorders, the complete American line provides for practically every application. Depending on instrument type and requirements, temperature ranges available are: minus 80° F. to plus 1150° F. Types of actuation include: mercury, vapor pressure, gas and bi-metal.

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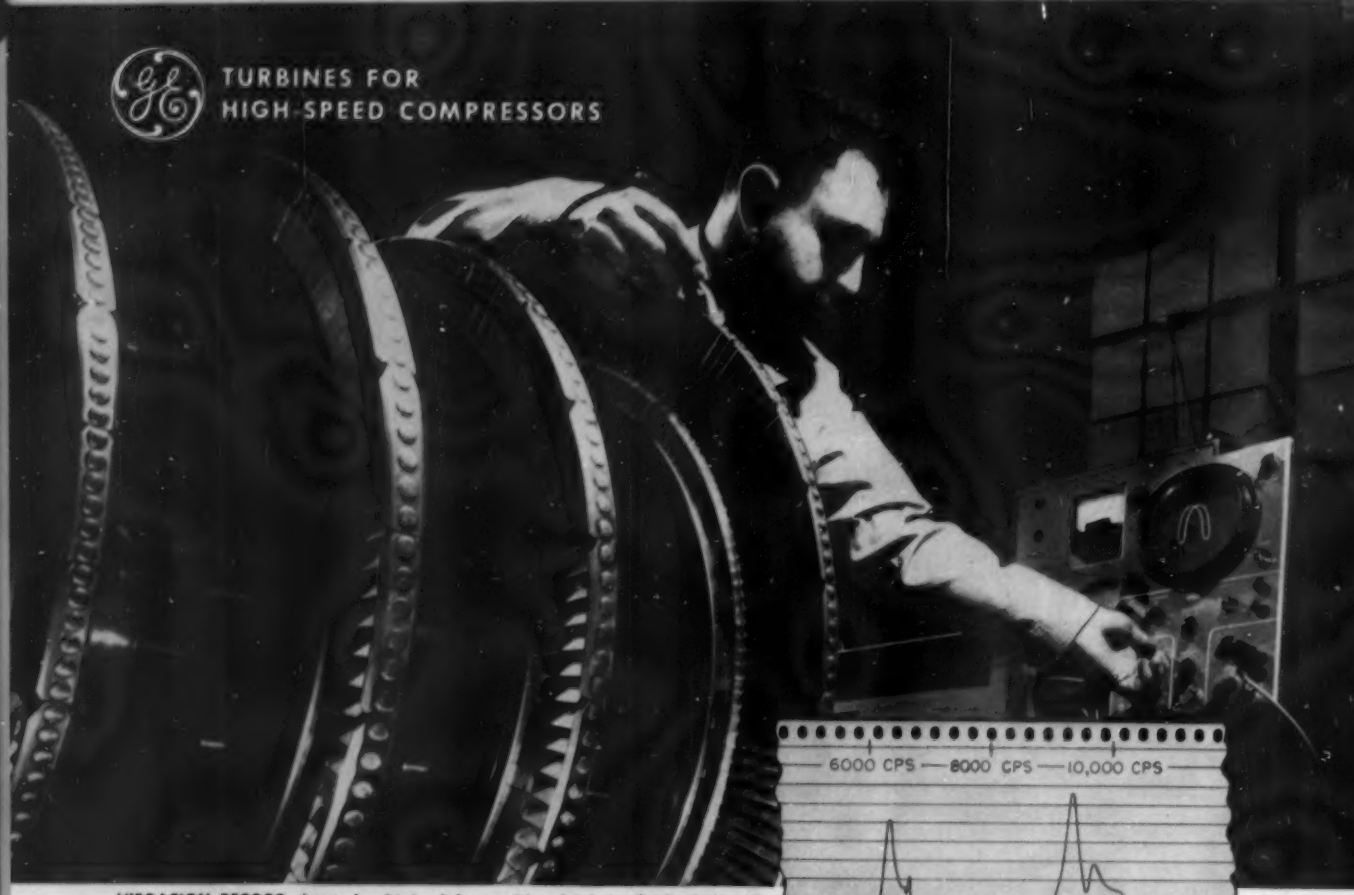
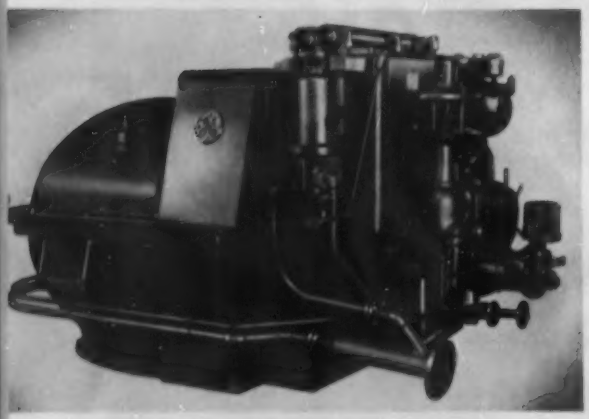
TURBINES FOR
HIGH-SPEED COMPRESSORS




**VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.**

# How G-E Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



**TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE**

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

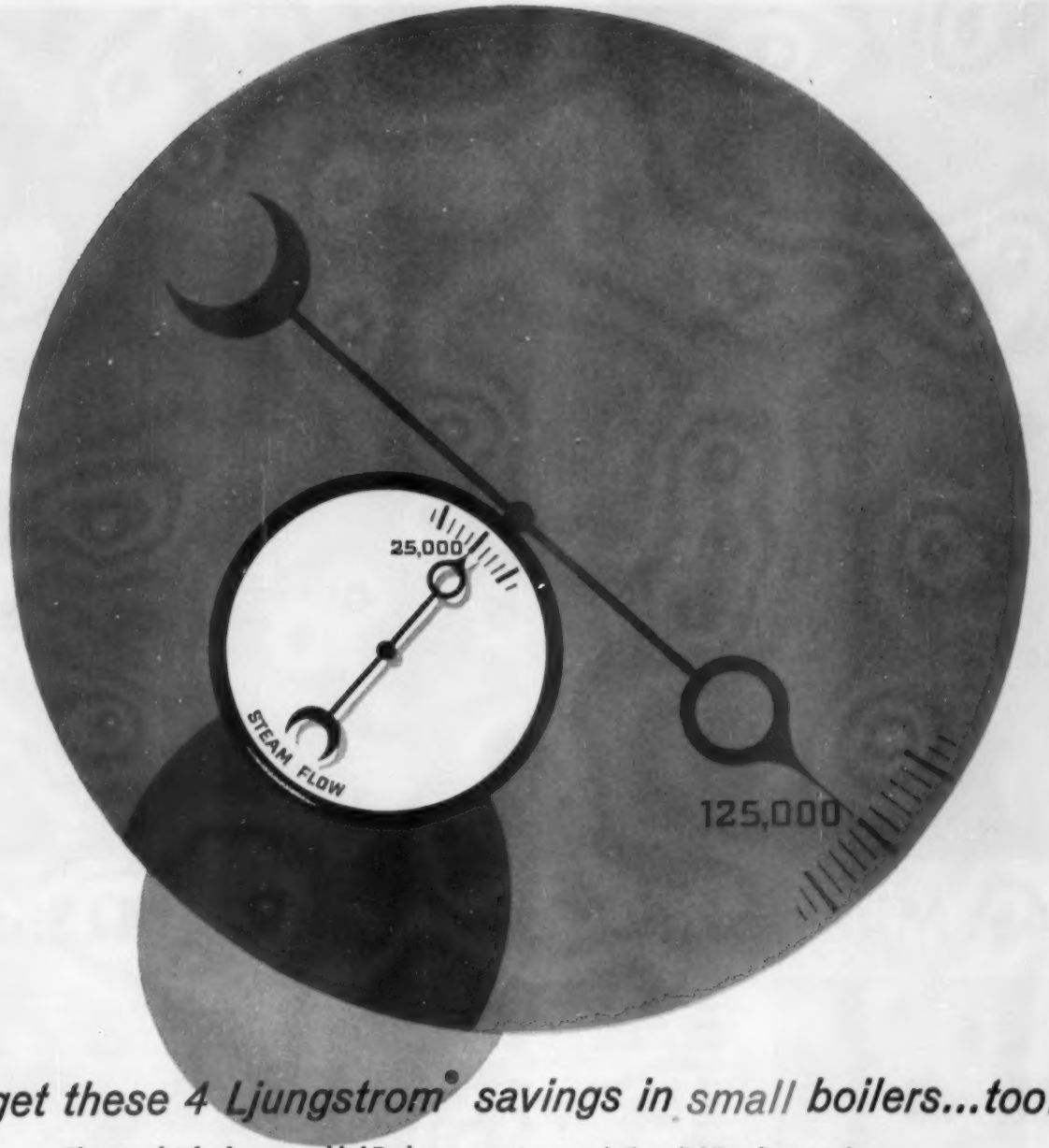
**HERE'S HOW** General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

**VIBRATION TESTING** is one of many features that add to the reliability of G-E high-speed turbines. For more information, contact your nearest G-E Apparatus Sales Office or write General Electric Company, Schenectady 5, N. Y. 241-2

*Progress Is Our Most Important Product*

GENERAL ELECTRIC




# *get these 4 Ljungstrom® savings in small boilers...too!*

The *completely shop-assembled* Package Ljungstrom Air Preheater brings to boilers as small as 25,000 pounds of steam per hour the four proved advantages of regenerative preheating:

1. **Saves fuel.** This reduction in fuel consumption can be sizeable . . . and can write off the cost of the unit in about a year. For in most installations yearly fuel costs match the initial cost of the boiler.

2. **Boosts boiler output.** Preheated air intensifies the combustion process. Heat absorption into boiler tubes increases correspondingly, raising the unit's capacity to produce steam.

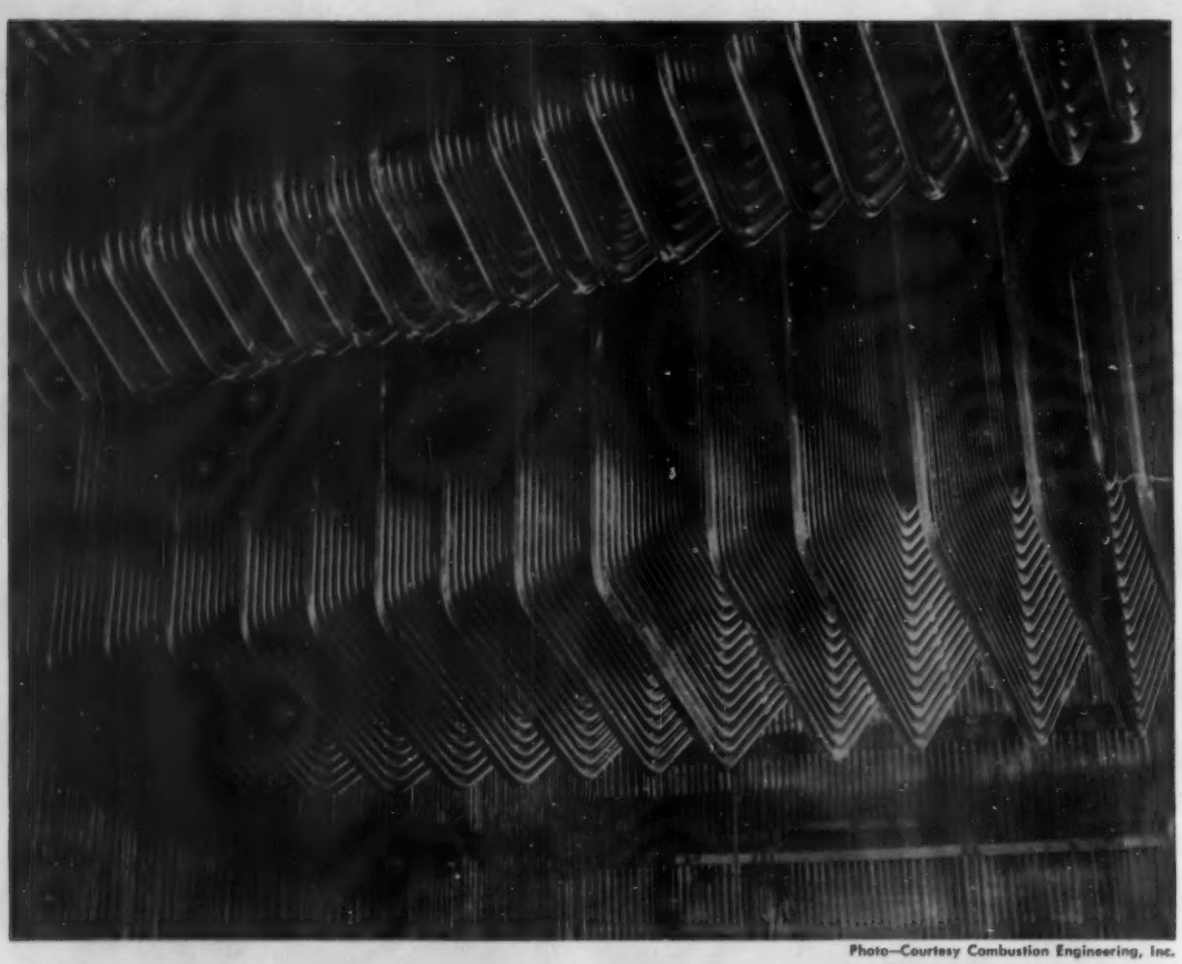
3. **Increases boiler reliability.** Since combustion is more efficient — fuel is burned more completely . . . there's less slagging . . . boilers stay on line longer. What's more, stack gases should be cleaner.

4. **Burns lower-grade fuels.** Higher furnace temperatures make practical the burning of lignites and similar low-grade fuels.

Find out how the efficient, low-cost Package Ljungstrom Air Preheater can be applied to your steam-generating units. Write, today, to The Air Preheater Corporation.

**The Package Ljungstrom operates on the continuous regenerative counter-flow principle. The heat-transfer surfaces on the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming combustion air.**

**The Air Preheater Corporation** 60 East 42nd Street, New York 17, N. Y.



Photo—Courtesy Combustion Engineering, Inc.

# 49 Miles of NATIONAL SEAMLESS

One of the huge superheater coils being hoisted into position.

**. . . make up this giant superheater.** And it's only a small portion of the total tubing used in this huge modern boiler. Here, steam at more than 2000 psi is superheated to 1000F. Severe as this duty is, it poses no problem for *seamless* tubes which, in fact, have been built to withstand much higher pressures and temperatures.

USS NATIONAL Seamless Pipe and Tubes are chosen almost invariably by designers and power engineers for boilers and high-pressure steam lines. They specify National Seamless as they always have in the past—secure in the knowledge that NATIONAL promises long, safe, and satisfactory service.

Even under the severest operating conditions, NATIONAL Seamless Pipe and Tubes have never been excelled for safe, efficient power plant service. Pierced from solid billets of steel, they have the strength, uniformity, and dependability of solid forgings. Each length is an homogeneous steel cylinder with uniform wall strength throughout, designed to remain structurally sound under high temperatures and tremendous pressures.

For full details on the use of NATIONAL Seamless in power installations, write for Bulletins 10 and 26. Or, if you're planning an installation, and would like some help, let our engineers give you a hand.

**SEE THE UNITED STATES STEEL HOUR.** It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

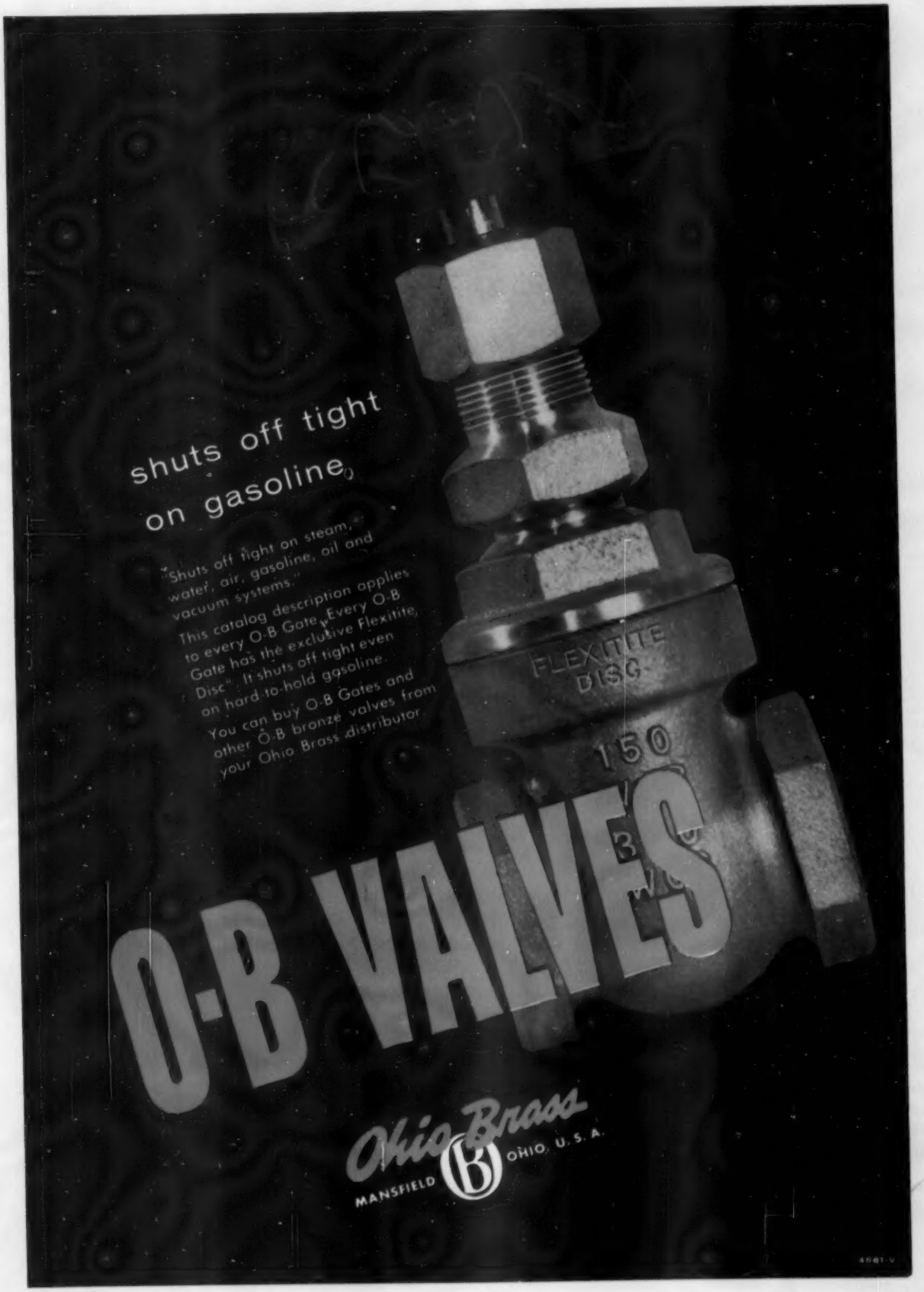
**NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.**

**(Tubing Specialties)**

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **NATIONAL Seamless PIPE AND TUBES**

UNITED STATES STEEL


shuts off tight
on gasoline
"Shuts off tight on steam, water, air, gasoline, oil and vacuum systems."
This catalog description applies to every O-B Gate. Every O-B Gate has the exclusive Flexitite Disc. It shuts off tight even on hard-to-hold gasoline.
You can buy O-B Gates and other O-B bronze valves from your Ohio Brass distributor
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150
O-B VALVES
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MANSFIELD
OHIO, U. S. A.

**Q. What does the Continental Automatic Boiler have that no other similar type boiler has?**

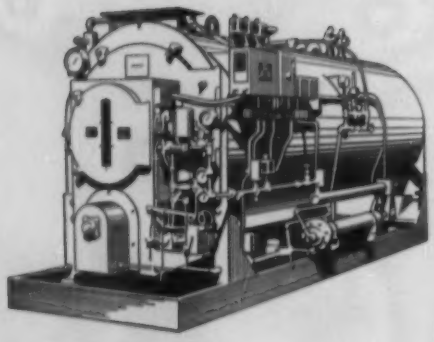
A. A special front-end design that employs two concentric rows of guide vanes which direct air in a spinning stream into the boiler, forming, in effect, a multiple-lead air-screw that provides uniform delivery of air and thorough mixing of air with fuel. Result: high rate of heat transfer to the surrounding water-cooled furnace — a reason why this 2-pass boiler has an efficiency of over 80% guaranteed.

Q. What outstanding features do the manufacturers of the Continental Boiler claim?

A. A special tube-sheet design that assures long service life. Water circulation that is uniform, free, rapid. 2-pass design that provides even flow of combustion gases to all heating surfaces. Heating surfaces arranged so that there is a centrally located furnace and equal spacing of all return tubes. Simplified construction that affords ease of accessibility and economy of maintenance.

Q. What was the comment made by an engineer who has followed packaged boiler design and construction for many years?

A. At the recent Power show this man gave an unsolicited testimonial. He said: "I've seen them all and I've never seen a packaged boiler built as well as this one." He specifically commented on the quality of the construction and the simplicity of build on the Continental Boiler.



Q. How can you get all of the facts on the Continental Boiler?

A. Right now, write for Bulletins BE3 and BE4 that describe the boiler and the "spinning gas technique". Write to Boiler Engineering & Supply Co., Inc., Phoenixville, Pa.

# OVERHUNG ROTOR DESIGN

## simplifies compressor installation and eliminates outboard bearing alignment problems

1 PERMANENT, BUILT-IN ALIGNMENT
Rotor support bearing cast integral with crankcase.

2 NO OUTBOARD BEARING
No alignment problems.

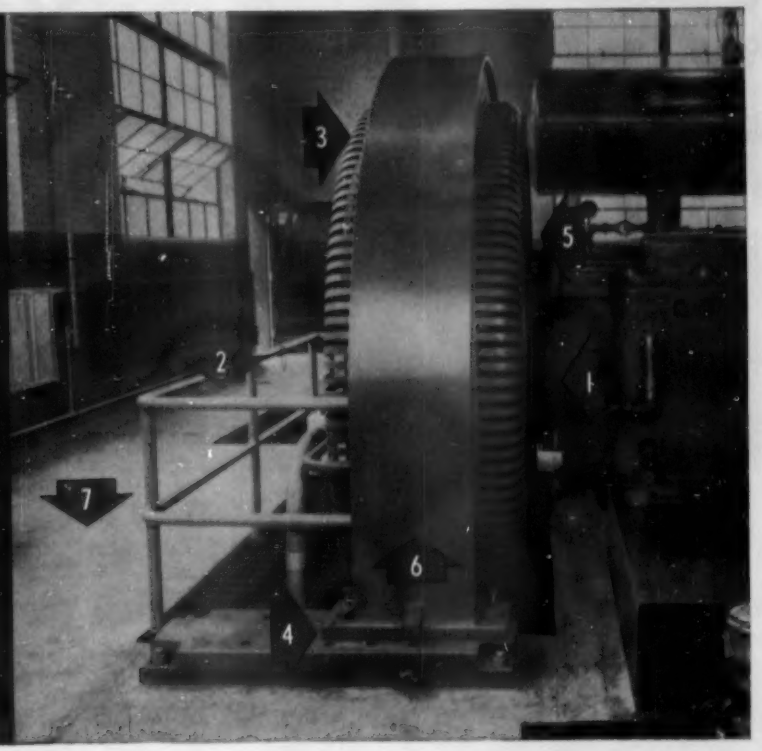
3 FLOATING ROTOR
While operating, rotor weight is supported on a cushion of magnetic force.

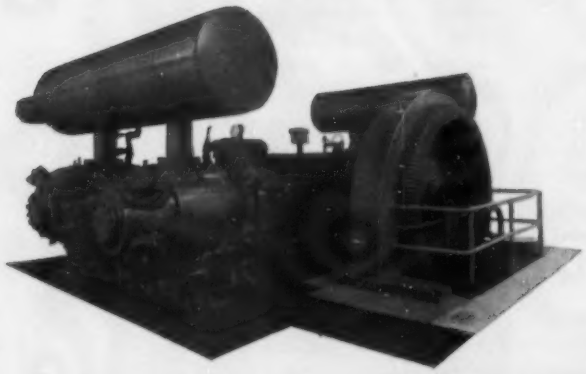
4 EASE OF INSTALLATION AND MAINTENANCE
Just set the stator down and slide it in place.

5 NO FLYWHEEL REQUIRED
Flywheel effect built into rotor.

6 ONE-PIECE STATOR
Elimination of stub shaft and outboard bearing permits use of one-piece stator and collector rings.

7 SAVES FLOOR SPACE
Close coupling reduces foundation size and floor area.



One of the many exclusive features of Clark Balanced/Opposed Compressors is the overhung rotor design.

With it, compressor installation is greatly simplified, floor space requirements are substantially reduced and alignment problems (inherent with outboard bearings) are nonexistent. Furthermore, elimination of the outboard bearing precludes bumping it out of alignment.

When the unit is operating, the magnetic lines of force fully support the rotor, with practically no weight carried by the integral bearing or shaft. Alignment is permanently built into Clark Balanced/Opposed Compressors.

For complete details on America's first and foremost Balanced/Opposed Motor-Driven Compressor — the compressor with *perfect balance* — write for Bulletin 118 and consult with your nearest Clark representative.

**CLARK BROS. CO. • OLEAN, N. Y.**
ONE OF THE DRESSER INDUSTRIES
Sales Offices in Principal Cities throughout the World

*PRECISION BY THE TON*

**CLARK balanced/opposed compressors**
150-4500 HP

# Attention to Detail is the Reason Why...

## *You Get More Value When You Buy* S-E-Co.

Take the nameplate pictured above . . . Actually it's more than a mere nameplate, it's a carefully designed cover for an access opening in the **new S-E-Co. Coal Valve.** A fitted, molded gasket makes it absolutely dust-tight. Step construction makes the inside face flush with the valve interior to assure good coal flow and eliminate what would otherwise be a pocket to catch water and cause corrosion. Wing nuts allow easy and quick removal and replacement.

Other small details that add up to a big difference are . . . stainless steel shells on the large ball bearing gate supporting rollers . . . deep groove in pocket sheave to insure good tracking of chain . . . heavy hand chain that comfortably fits operators hands and is hot galvanized to prevent its rusting . . . lap closure of gate on all four sides to assure positive cutoff and ease of closing through standing column of coal . . . self-cleaning racks and pinions.

The best costs little more than the average and quickly pays for itself. For a complete list of the outstanding features of the new S-E-Co. Coal Valve write for Bulletin No. 97.

**STOCK Equipment Company**

745-P, HANNA BLDG., CLEVELAND 15, OHIO

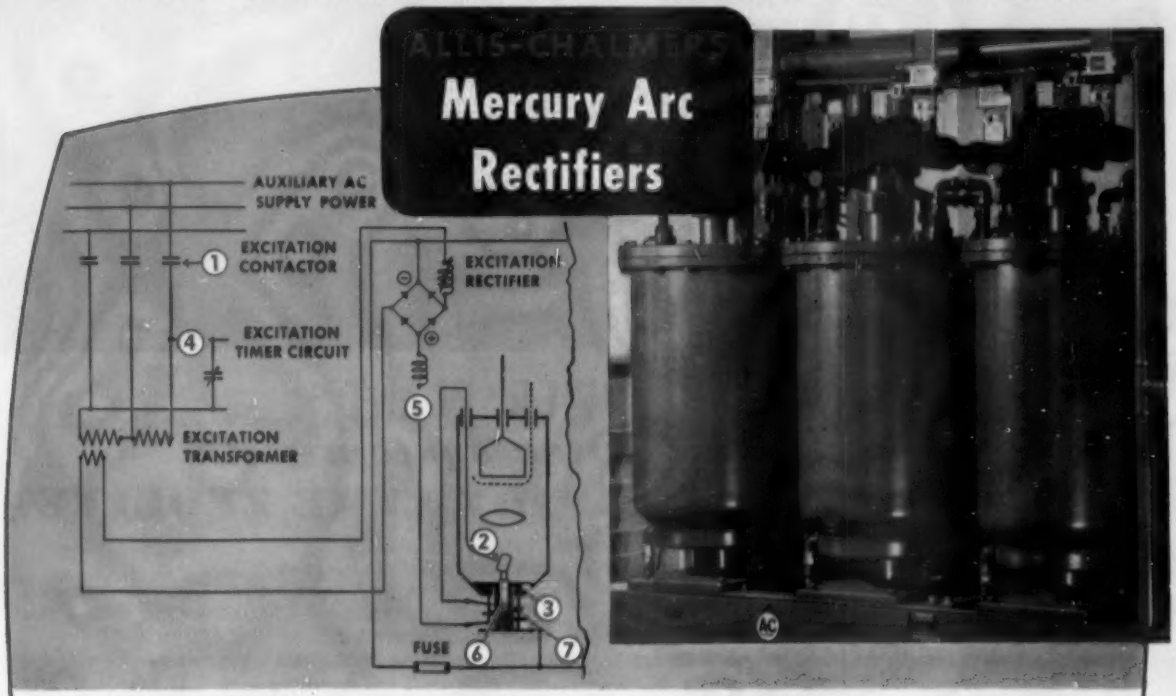
## For Reliable Rectifier Operation Get

# Continuous Excitation

Allis-Chalmers excitron rectifiers eliminate the need for a pulse-type firing system timed for operation every cycle. Maintenance is easy because of the simplicity of design.

A small dc excitation arc is automatically ignited only once, when the unit is started, and then maintained on the mercury cathode of each rectifier tube. It offers advantages similar to a pilot light. Since it is far easier to maintain an arc than to start it, this feature makes the excitron far less likely to lose excitation during power supply disturbances than other types of rectifiers.

Get all the facts about excitron rectifiers before your next installation. Call the A-C office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.




### Supply of DC Provides Key to Continuous Excitation

Direct current supplied from excitation rectifiers is the key to continuous excitation. When the excitation system is energized by means of a contactor (1), positive dc potential appears on the excitation anode (2) of each tube, negative at the cathode (3). A timer (4), through contacts of the excitation failure relay (5), is energized at the same time.

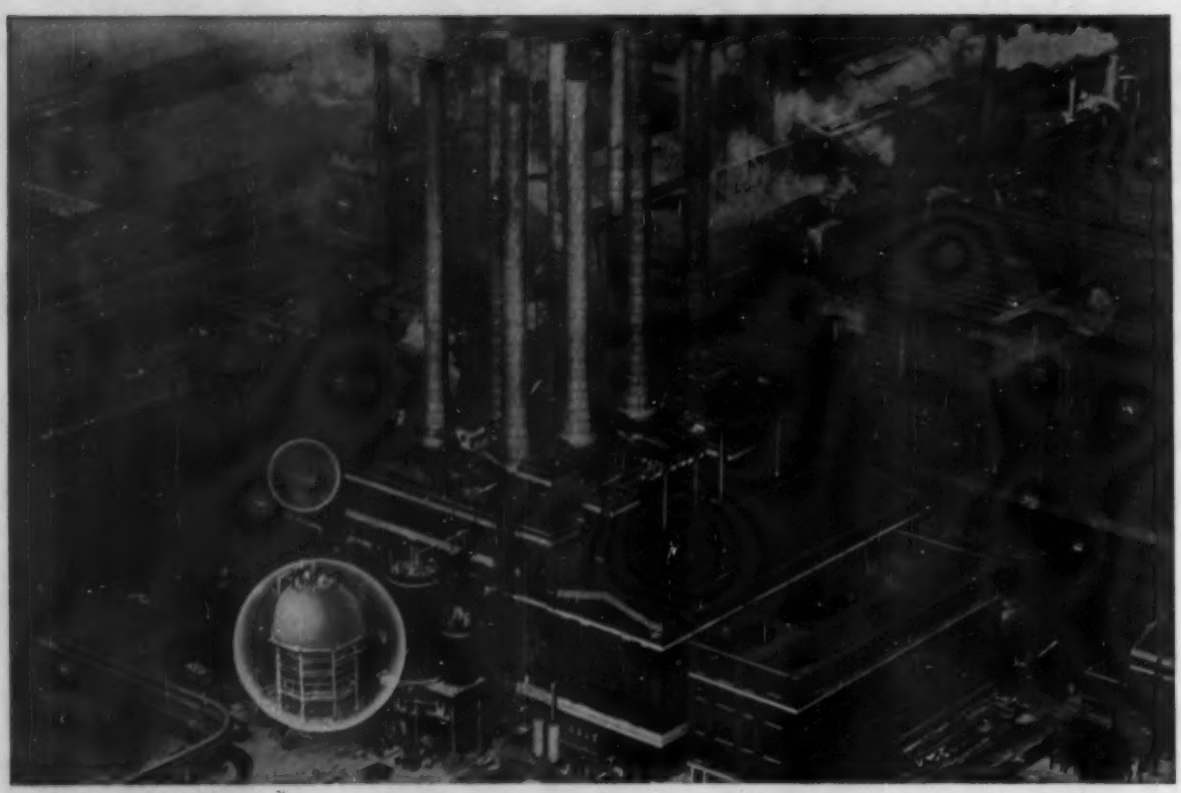
As soon as voltage is applied, current flows from the anode to the cathode through the ignition plunger (6). This current energizes the ignition coil (7) and causes the plunger to be pulled below the mercury surface. As the plunger travels down, an arc is drawn which transfers from the graphite tip of the plunger to the mercury. This current flow keeps the coil energized, maintaining a continuous arc.

If excitation failure should occur while the rectifier is carrying load, the plunger is released, floating upward in the mercury until it makes contact with the anode, then repeating the process above until the arc is re-established.

Re-establishment of the arc as outlined takes less than a second — it does not interfere with normal operation.

**ALLIS-CHALMERS**

A-4592



# FORD RIVER ROUGE POWER PLANT

## *modernizes water system with*

## Cochrane HOT LIME ZEOLITE

A Cochrane 200,000 gph Hot Lime Zeolite System answers the treated water requirements of higher quality and increased capacity at the world-famous Ford River Rouge Power Plant . . . and at an estimated savings of $49,000.00 a year in operating cost!

The Kuljian Corporation, consulting engineers, in collaboration with Ford engineers, have assured adequate feedwater supply for the boilers. Ample supply is also available for future high pressure boilers even though the service may require 100% makeup water.

The system consists of one of the world's largest single unit, Sphericalhead design, hot lime softeners to reduce alkalinity to 25 ppm, a battery of pressure filters to remove turbidity, and hot zeolite softeners to produce an effluent practically free from hardness.

To provide oxygen free feedwater, a Cochrane deaerating heater with a capacity of 1,500,000 lbs./hr. follows this Hot Lime Zeolite plant.

*Cochrane is the pioneer and largest manufacturer of hot process softeners and deaerating heaters.* Hundreds of early hot process installations have been converted to Hot Lime Zeolite by Cochrane, with resultant high quality water such as that required by Ford's River Rouge Plant.

If your problem is a new installation or the conversion of an old plant, our engineering background in water conditioning will provide the most economical method to meet your requirements. Why not contact Cochrane today?

**Cochrane**

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# Strange Genius

ASK ANY GROUP of power men to name those who laid the foundation for today's electrical generation and distribution. You'll wind up with an impressive list—Edison, Brush, Thomson, Westinghouse, many others. But there is almost sure to be a significant omission.

Yet this forgotten man conceived the polyphase ac motor—still basic—and devised a suitable system of generation and distribution for applying it. To grasp the magnitude of this contribution, we must turn back to the 1880's when the electrical era was being born, and the "battle of the systems" held sway.

Arc lights and motors were being operated on constant-current series systems. Edison's Pearl Street generating station had opened in 1882, supplying incandescent lamps and, later, dc motors on a constant-potential system. Under the leadership of Westinghouse and Stanley, the advantages of ac distribution were demonstrated. But there was no successful ac motor.

In May, 1888, a young Yugo-Slav engineer, but four years in the United States, read a paper before the American Institute of Electrical Engineers. In it he described a new ac system. Its heart was the induction motor with its basic and beautiful concept of the rotating magnetic field. The man was Nikola Tesla, the system he described was destined to sweep the field.

With characteristic vision, George Westinghouse realized the fundamental importance of the polyphase ac system and acquired the basic patents. Its first impact on the general public was at the Chicago World's Fair of 1893. There a 2-phase generator supplied motors and lamps, and, through rotary converters and motor-generators, a variety of dc equipment.

But it remained for the Niagara Falls power project to demonstrate in the most dramatic way possible that polyphase ac was the system of the future. Since 1886 when a charter to develop its power had been granted, the eyes of the world had been on Niagara. An international commission, headed by Lord Kelvin, had reviewed 17 proposals, found none acceptable. Later, just five years after Tesla's AIEE paper, it was officially decided to use the polyphase system.

In August, 1895, Niagara power was delivered to the first industrial customer and in 1896 ac transmission to Buffalo, 22 miles away, was begun. By that time, the steam turbine had been introduced in America and the modern age of electric power had truly opened.

For Nikola Tesla, these far-reaching inventions were but a beginning. Still to come was brilliant work in high frequencies, thinking basic to much of today's radio art. Yet by the time of his death in 1943, both he and his work had begun to slip into obscurity. Why?

A man of flashing insights and enormous brilliance, Tesla was largely indifferent to the development of his ideas. This he left to others while he followed the lure of new challenges. In later years, his projects became more grandiose, his ways more mysterious, his pronouncements more Olympian. And working alone, as he did, he formed none of the institutional ties that help to perpetuate a record of accomplishment.

Next year—July 10, 1956—will be the 100th anniversary of Nikola Tesla's birth. It would be fitting for our engineering societies to commemorate this occasion, to acknowledge our debt to this strange and lonely genius who changed our world for the better.

# FIVE CENTRAL

# SPECIFY 30 KENNEDY

## selection based on proven

FULLY AIR SWEPT

•

COAL PULVERIZED TO SUPERFINENESS

•

COAL COMPLETELY CARBURETED . . .
Ready for combustion

•

BIG TRUNNIONS FOR AIR SWEEPING

•

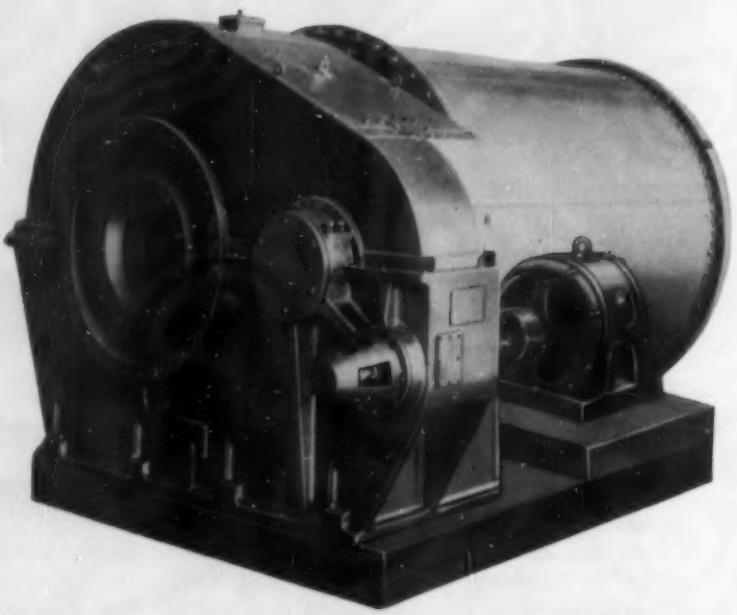
BALLS ADDED WITHOUT SHUTTING DOWN

•

LOW OPERATING AND MAINTENANCE COSTS

•

UNBURNT CARBON LOSSES LESS THAN ½%



AIR SWEPT TUBE MILLS Slow-speed ball mill for perfect pulverization. Low-cost grinding, regardless of hardness. Balls can be added without shutting down. Continuous operation, better than 99% availability.

The contracts placed by these five important Central Power Stations involve 30 KVS Air Swept Tube Mills, designed to pulverize coal for generation of 6,350,000 lbs of steam per hour in John Thompson boilers. The following plants and equipment are included:

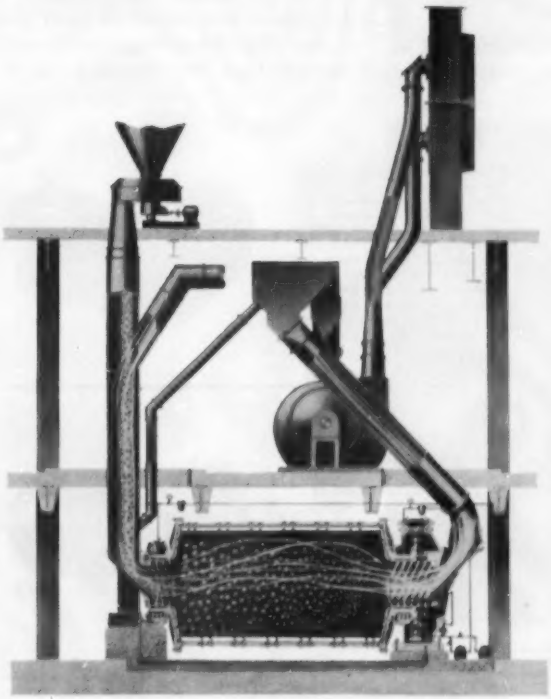
TILBURY POWER STATION, LONDON—five units, each designed for 550,000 lbs. per hour at 950 lbs. per sq. in. and 925° F.
MARCHWOOD POWER STATION, LONDON—four units, each designed for 550,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.
BRIMSDOWN POWER STATION, LONDON—two units, each designed for 340,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.
PULROSE POWER STATION ISLE-OF-MAN —two units, each designed for 60,000 lbs. per hr. at 425 lbs. per sq. in. and 775° F.
WALLERAWANG POWER STATION, AUSTRALIA —two units, each designed for 300,000 lbs. per hr. at 650 lbs. per sq. in. and 870° F.

IT COSTS LESS.. TO OWN THE BEST!

# POWER STATIONS

## AIR SWEPT TUBE MILLS

## economy of operation!



KENNEDY COAL FIRING SYSTEM showing disc feeder, pulverizer, classifier, exhauster and burners.

For maximum combustion with all grades of coal, KENNEDY Air Swept Tube Mills have no equal. The cumulative savings in fuel costs made possible through complete combustion, reach tremendous amounts. Maximum heat value is obtained from every ton of coal burned producing *more heat and more power* from any given quantity of coal.

KENNEDY Air Swept Tube Mills are built to provide extremely fine pulverization, making possible the efficient burning of any grade of coal from the cheapest to the highest. Save money on your coal costs. Stop buying premium coal and *save more than a dollar per ton!* KENNEDY equipment will do this for you. Get the facts today.

**INSTANT RESPONSE TO CONTROLS**

•

**85% TO 90% THROUGH 200 MESH**

•

**20% MOISTURE REMOVED WHILE PULVERIZING**

•

**PULVERIZES *ANY* COAL, BITUMINOUS, ANTHRACITE, COKE BREEZE**

•

**TRAMP IRON ACTUALLY AIDS IN PULVERIZING**

•

**RESERVES OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND**

*SEND FOR bulletins describing KVS coal firing systems and waste heat boilers.*

**KENNEDY-VAN SAUN**
**MANUFACTURING & ENGINEERING CORPORATION**
**TWO PARK AVENUE, NEW YORK**
***FACTORY* DANVILLE, PA.**

*For liquid-handling economy*

# select the right pump for the job

Goulds pumps are designed for easy maintenance and built so they need a minimum of it.

These seven groups of pumps are only a few of the many models made by Goulds—yet in these groups are pumps for hundreds of industrial liquid-handling jobs—242 combinations of pump models, sizes and materials.

Standardization of parts for interchangeability among different groups of pumps helps keep your parts inventory low. And most models are available in a variety of materials to suit varying liquid-handling requirements.

Many other unique features mean fewer maintenance worries for you, longer service life. Support heads have a cooling chamber preventing transfer of heat to bearings. Shaft sleeves are shouldered on the shaft near the impeller. They expand and contract freely with temperature changes. Sealed housings keep dirt and moisture out of the ball bearings.

Specify Goulds pumps and take advantage of their cost-saving features. Your Goulds representative will help you select the pumps best suited to your needs. Consult him on your liquid-handling problems, or write direct to Goulds Pumps, Inc., Seneca Falls, N. Y.

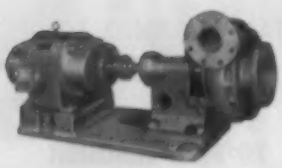
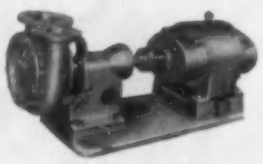


**Fig. 3765** single-stage, enclosed impeller pump, available in 21 sizes providing capacities up to 3,500 GPM, heads to 400 ft. Extra-heavy construction throughout, for trouble-free service 24 hours a day, over long periods. Send for Bulletin 715.1 for specifications, performance curves.

**Fig. 3715** single-stage, chemical pump for handling corrosive and abrasive liquids. 9 sizes provide capacities up to 720 GPM, heads to 200 ft. Available in Types 316 and Gould-A-Loy stainless steel, all-bronze, all-iron, bronze-fitted, or iron or bronze with stainless trim. Ask for Bulletin 725.4.



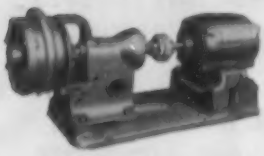
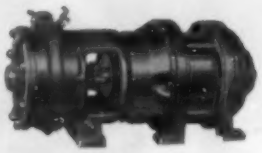


**Fig. 3345** two-stage pumps in 5 sizes provide heads up to 500 ft., and capacities to 120 GPM. Impellers mounted back-to-back neutralize end thrust. Impeller clearance easily adjusted by external means. Write for Bulletin 718.2.

**Fig. 3320** "close-cupid" two-stage pump, in 5 sizes, provides heads to 500 ft., capacities to 120 GPM. Impellers mounted back-to-back, directly on extended motor shaft. Permanent alignment assured by recessed lock fit on adapter. Ask for Bulletin 713.1.



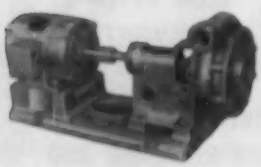
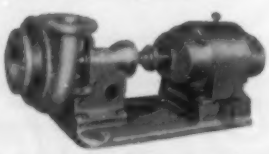


**Fig. 3770** single-stage, enclosed impeller pump, with belt or motor drive. 14 sizes with capacities ranging from 10 to 1,800 GPM, and heads to 120 ft. Ideal for clear liquid applications. Available in all-iron, all-bronze or bronze-fitted construction. Write for Bulletin 622-A2.

**Fig. 3189** single-stage, open impeller pumps, with belt or motor drive. 10 sizes provide capacities up to 1,080 GPM, heads to 180 ft. Especially built for handling slurries, other solids —containing liquids. For specifications, performance curves, write for Bulletin 720.4.



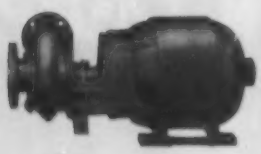


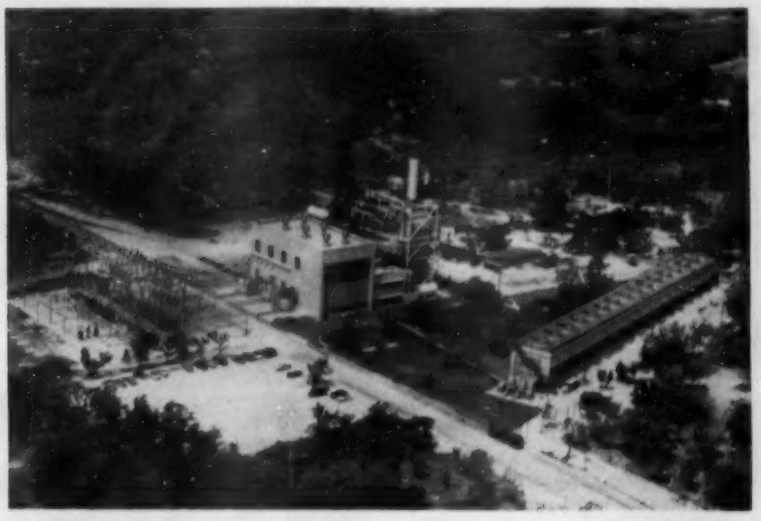
**Fig. 3660** single-stage "close-cupid" pump, for motor or turbine drive. 20 sizes offer capacities to 2,600 GPM, heads to 400 ft. All units are self-contained, need no special foundation. Open-top construction gives ready access to gland and stuffing box. Available in all-iron, all-bronze, or bronze-fitted construction. Send for Bulletin 710.1 to get specifications, performance curves, other details.

Goulds PUMPS INC. Seneca Falls New York

Atlanta • Boston • Chicago • Houston • New York • Philadelphia • Pittsburgh • Tulsa

B G A SKROTZKI
*Associate Editor in Charge*

**LEON CREEK** has three units with outdoor boilers and enclosed turbine-generators



**W B TUTTLE PLANT,** also semioutdoor, with one unit will soon have 100-mw addition

# San Antonio's plants feature low cost

**Modern high-pressure semioutdoor plants, using cooling towers, were erected with modest investment. Here's the breakdown on costs of four new steam units fired with natural gas**

By JOHN H HOCHULI
*Project Engineer,*
*Gibbs & Hill, Inc.*

► CONTINUING population and industrial growth in the San Antonio, Texas, area keeps raising the demand for electrical power. In 1942, when the city bought the local utility system it had 97,000-kw capacity. Today with four plants, the system capacity has grown to 271,000 kw.

Of the two most recent plants, Leon Creek was built first. Unit 1 at this plant was described in September 1950, POWER, p 94-97. Unit 1 started turning out kwhr in August 1949. Unit 2, a duplicate of Unit 1, started in 1951.

**New unit.** Mushrooming demand led to installing Unit 3 with a rated capability of 66,000 kw in 1953. Its outdoor radiant-type boiler can produce 650,000 lb per hr of 1350-psi 950-F steam. The boiler primarily burns natural gas with oil as emergency standby. Since the unit has a pres-

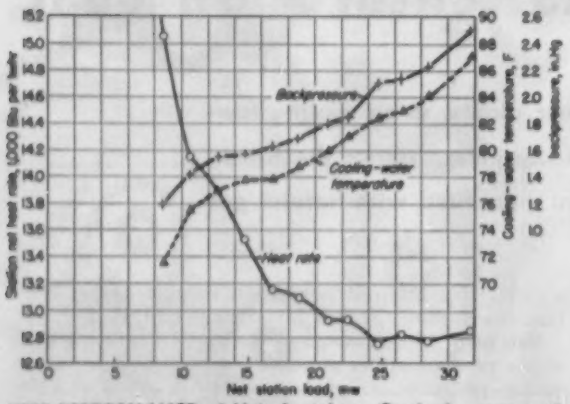
## Table I–Installed cost, Unit 1, WB Tuttle Plant

Rated capability 66 mw
Actual capability 78 mw

| Item | Total cost | Cost/kw (66 mw) | Cost/kw (78 mw) |
|---|---|---|---|
| Land | $ 118,588 | $ 1.80 | $ 1.52 |
| Buildings | 1,129,011 | 17.11 | 14.48 |
| Boiler-plant equipment | 2,490,912 | 37.74 | 31.93 |
| Turbine-generator units | 3,002,489 | 45.50 | 38.48 |
| Accessory electric equipment | 444,978 | 6.74 | 5.71 |
| Misc power-plant equipment | 55,059 | .83 | .71 |
| Substations | 896,081 | 13.58 | 11.49 |
| Furniture | 6,812 | .10 | .09 |
| Gas lines and equipment | 7,532 | .11 | .10 |
| Totals | $8,151,462 | $123.51 | $104.51 |

**OUTDOOR BOILERS** of Leon Creek are served by two stacks. Stack for Units 1 and 2 hides Unit 3's stack, standing on top of boiler structure in the right-hand side of plant building

**TURBINE GENERATOR UNITS** of Leon Creek have five bleed points each. Unit 3, *left*, has 66-mw rated capability; Units 2 and 1, *right*, have each 33-mw rated capability (actual is much higher)




**TEST PERFORMANCE** of Unit 1 at Leon Creek shows over-all heat rate for cooling-water temperature rising with net load

surized furnace no induced-draft fan has been installed. Forward-thinking design has provided for possible future conversion to lignite burning. Furnace setting is high enough to allow installing ash hoppers. Pulverizers would prepare the lignite for suspension burning.

The tandem-compound turbine works in a regenerative cycle, with five bleed points feeding four closed heaters and one deaerating heater. The lowest-pressure closed heater has an external drain cooler. The other closed heaters have internal drain-cooling sections. One evaporator handles makeup pretreated in a hot-process lime-soda-ash softener.

Scarcity of water makes induced-draft cooling towers necessary for main condenser service and general station-cooling needs. Water comes from three artesian wells.

**Generating costs.** Table 2 shows the breakdown of the

## Table 2 – Installed costs of Leon Creek Units

| Unit No. | 1 | | 2 | | 3 | | Total plant |
|---|---|---|---|---|---|---|---|
| Year installed | 1949 | | 1951 | | 1953 | | — |
| Rated capability, kw | 33,000 | | 33,000 | | 66,000 | | 132,000 |
| | Total cost | Cost/kw | Total cost | Cost/kw | Total cost | Cost/kw | Cost/kw |
| Land | $ 45,331 | $ 1.37 | $ 0 | $ 0 | $ 0 | $ 0 | $ .34 |
| Buildings | 596,836 | 18.09 | 348,773 | 10.57 | 688,520 | 10.43 | 12.38 |
| Boiler-plant equipment | 968,171 | 29.33 | 923,857 | 28.00 | 2,564,946 | 38.86 | 33.78 |
| Turbine-generator units | 1,330,836 | 40.33 | 1,470,207 | 44.55 | 2,669,300 | 40.44 | 41.49 |
| Accessory equipment | 261,779 | 7.94 | 162,082 | 4.91 | 555,398 | 8.42 | 7.42 |
| Misc power equipment | 21,291 | .65 | 19,166 | .58 | 3,095 | .05 | .33 |
| Substations | 216,508 | 6.56 | 286,183 | 8.67 | 558,992 | 8.47 | 8.04 |
| Furniture | 1,488 | .05 | 180 | .01 | 0 | 0 | .01 |
| Miscellaneous equipment | 188 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas lines and equipment | 15,009 | .45 | 11,256 | .34 | 593 | .01 | .20 |
| Totals | $3,457,437 | $104.77 | $3,221,704 | $97.63 | $7,040,844 | $106.68 | $103.99 |

## Table 3 – Leon Creek annual production expenses

| Period, fiscal year ending | 8-1-50 | | 1-31-51[2] | | 1-31-52 | | 1-31-53 | | 1-31-54 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Installed capacity, mw | 30 | | 30 | | 60 | | 60 | | 120 | |
| Net generation, $10^6$ kwhr | 184.4 | | 89.6 | | 333.4 | | 429.5 | | 648.5 | |
| Plant factor, % | 70 | | — | | — | | 82 | | — | |
| 60-min peak demand, mw | 33.4 | | 34.4 | | 68.4 | | 67.7 | | — | |
| Connected to load, hr | 8,431 | | 3,651 | | 8,553 | | 8,760 | | 8,760 | |
| PRODUCTION EXPENSES: | $1000 | Unit[1] | $1000 | Unit[1] | $1000 | Unit[1] | $1000 | Unit[1] | $1000 | Unit[1] |
| Oper labor, superv, engrg | 69 | 0.37 | 38 | 0.42 | 92 | 0.28 | 94 | 0.22 | 131 | 0.20 |
| Water | 3 | 0.02 | 2 | 0.02 | 14 | 0.04 | 21 | 0.05 | 40 | 0.06 |
| Oper supplies, expenses | 7 | 0.04 | 4 | 0.04 | 10 | 0.03 | 10 | 0.02 | | |
| Maintenance | 36 | 0.19 | 31 | 0.36 | 86 | 0.26 | 62 | 0.14 | 123 | 0.19 |
| Fuel | 298 | 1.62 | 146 | 1.63 | 549 | 1.64 | 721 | 1.68 | 1018 | 1.57 |
| Total | 413 | 2.24 | 221 | 2.47 | 751 | 2.25 | 908 | 2.11 | 1312 | 2.02 |
| Gas burned, $10^6$ cu ft | 2,203 | | 1,089 | | 4,065 | | 5,235 | | 7,221 | |
| Heating value, Btu per cu ft | 1,080 | | 1,071 | | 1,065 | | 1,066 | | — | |
| Fuel cost, ¢ per $10^6$ Btu | 12.52 | | 12.52 | | 12.69 | | 12.92 | | 12.39 | |
| Heat rate, Btu per net kwhr | 12,895 | | 13,022 | | 12,988 | | 12,999 | | 12,182 | |
| Average number of employes | 23 | | 27 | | 34 | | 31 | | 45 | |

[1]Unit cost, mills per kwhr [2]Six months ending 1-31-51

installed costs of each unit and the entire station. Installed cost for these units stands in the lower end of the range of unit costs for gas- and oil-fired plants built since 1946. See POWER's Data Sheet, February 1955, p 109.

Table 3 shows the annual production expenses for Leon Creek since the first unit started running. Unit 1 was completely overhauled in 1951 and in 1953, Unit 2 in 1953.

Here's the breakdown on the maintenance costs for fiscal year ending Jan 31, 1955:

| | |
|---|---|
| Supervision and engineering, plant force | $15,187 |
| Supervision and engineering, general office | 1,584 |
| Maintenance of structure and improvements | 8,006 |
| Maintenance of furnaces and boilers: | |
| Unit 1 | 6,187 |
| Unit 2 | 2,957 |
| Unit 3 | 12,979 |
| Maintenance of boiler apparatus | 10,553 |
| Maintenance of cooling towers: | |
| Unit 1 | 3,206 |
| Unit 2 | 4,984 |
| Unit 3 | 3,897 |
| Maintenance of steam piping | 1,022 |
| Maintenance of prime mover and generator: | |
| Unit 1 | 4,251 |
| Unit 2 | 5,751 |
| Unit 3 | 11,978 |
| Maintenance of accessory electrical equipment | 2,641 |
| Maintenance of miscellaneous power-plant equipment | 2,648 |
| Total maintenance cost | $97,831 |


More on next page

## PRINCIPAL POWER-PLANT EQUIPMENT

**Leon Creek, Unit No. 3, City Public Service Board, San Antonio, Texas**
**W B Tuttle, Unit No. 1, essentially duplicates Leon Creek Unit No. 3**

### *STEAM-GENERATING EQUIPMENT:*

Boiler, 1 ..... Babcock & Wilcox Co
Radiant type, 650,000 lb per hr, 1350 psi, 950 F, oil and gas fired, provisions for future Ignite firing, pressurized furnace, outdoor, no induced-draft fan, boiler and waterwall surface 8300 sq ft, economizer surface 19,100 sq ft, heat release 29,500 Btu per hr per cu ft
Air heater, 3 ..... Babcock & Wilcox Co
Tubular, 125,000 sq ft
Forced-draft fans, 2 ..... American Blower Corp
For pressurized furnace, damper and vane control, 400-hp motor drive
Fuel-oil pumping and heating ..... A M Lockett & Co
Blowoff and drain valves ..... Yarnall-Waring Co
Attemperator water-flow control ..... Bailey Meter Co
Water column ..... Diamond Power Specialty Corp
Combustion-control system ..... Bailey Meter Co

### *POWER-GENERATING EQUIPMENT:*

Turbine-generator, 1 ..... Westinghouse Electric Corp
60,000/66,000 kw preferred standard unit, 1250 psi, 950 F, 3600 rpm, 5 bleed points, direct-connected exciter and pilot exciter, hydrogen-cooled generator
Condenser, 1 ..... Westinghouse Electric Corp
55,000 sq ft surface, 2-pass, Muntz metal tubes
Steam-jet air ejector, 1 ..... Westinghouse Electric Corp
Circulating water pumps, 3 ..... Westinghouse Electric Corp
Total capacity 55,000 gpm, 600-hp motor drives
Cooling tower, 1 ..... C H Wheeler Manufacturing Co
Induced draft, redwood, 14 cells, 60-hp fan-drive motors
Circulating-water piping ..... Grinnell Co
Butterfly valves ..... Henry Pratt Co

### *FEEDWATER SYSTEM:*

Condensate pumps, 2 ..... Westinghouse Electric Corp
Boiler feed pumps, 3 ..... Ingersoll-Rand Co
Seven-stage centrifugal, single suction, one pump is spare
Boiler-feed pump drives, 3 ..... Westinghouse Electric Corp
900-hp induction motors, 3560 rpm
Feedwater heaters, 4 ..... Westinghouse Electric Corp
No. 1 low-press. 1630 sq ft, external 455-sq-ft drain cooler
No. 2 low-press. 1480 sq ft, internal drain cooler section
No. 4 high-press. 2310 sq ft, internal drain cooler
No. 5 high-press. 2120 sq ft, internal drain cooler
All are horizontal closed heaters
Deaerating heater, 1 ..... Elliott Co
600,000 lb per hr, 70-psig, 10-min storage tank
Evaporator, 1 ..... Westinghouse Electric Corp
350-sq-ft horizontal steam tube bundle
Boiler feed-pump recirculation control ..... Bailey Meter Co
Feedwater treatment ..... Belco Industrial Equipment Division
Hot-process lime-soda-ash softener, 30,000 lb per hr

### *ELECTRICAL EQUIPMENT:*

Outdoor oil circuit breakers ..... General Electric Co
Auto transformer ..... Moloney Electric Co
Disconnect switches ..... Delta-Star Electric Div
138-kv line relaying equipment ..... Westinghouse Electric Corp
Switchboard control panel ..... Westinghouse Electric Corp
Lightning arresters, Outdoor potential transformers ..... General Electric Co
Oil circuit breakers, Bushing current transformers, potential devices ..... Pacific Electric Mfg Corp
Indoor switchgear ..... Westinghouse Electric Corp
Power and distribution transformers ..... General Electric Co
Auxiliary motor-control center ..... Westinghouse Electric Corp

### *MISCELLANEOUS EQUIPMENT:*

Instruments and recorders ..... Leeds & Northrup Co
Control valves ..... Atwood & Morrill Co
Rubber expansion joints ..... Moisson Packing & Rubber Co
Turbine-type pumps ..... Worthington Corp
Pressure-reducing valves ..... Republic Flow Meters Co
Nozzle-type safety valves ..... S A Machine & Supply Co
Centrifugal pumps ..... Ingersoll-Rand Co
Control valves ..... Foster Engineering Co
Check valves ..... Edward Valves, Inc
Gate, globe and check valves ..... Wm Powell Co
Expansion joint ..... American District Steam Co
Liquid level and pressure controls ..... The Mercoid Corp
Passenger elevator ..... Otis Elevator Co
Control valves ..... Manning, Maxwell & Moore, Inc
Globe, gate and check valves ..... Lunkenheimer Co
Globe valves ..... Walworth Co
Industrial thermometers ..... Manning, Maxwell & Moore, Inc
Globe and angle valves ..... Crane Co
Level gages ..... The Liquidometer Corp
Pressure gages ..... Manning, Maxwell & Moore, Inc
Air receiver ..... Ingersoll-Rand Co
Traps ..... Yarnall-Waring Co
Lubricated plug valves ..... American Car & Foundry Co
Communication equipment ..... Stromberg-Carlson Co
Boiler-control annunciator ..... Auth Electric Co
Vacuum gage ..... Taylor Instrument Co
Control valves ..... Fisher Governor Co
Humidifier float valve ..... Scovill Mfg Co
Twin strainer ..... Elliott Co
Control valve ..... Mason-Neilan Regulator Co
Sulfuric acid feeder ..... Proportioneers, Inc, Div B-I-F Industries

**ENGINEERS AND CONSTRUCTORS..... GIBBS & HILL, INC**

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The low-range investment costs are backed up by modest maintenance and operating costs giving a low over-all cost per kwhr.

**Newest plant.** Latest expansion, completed in 1954, was Unit 1 at the new W B Tuttle Plant. With 66,000-kw rated capability it duplicates No. 3 at Leon Creek. Table 1 shows the breakdown of investment costs. Comparison with Table 2 shows the differences largely caused by Tuttle Unit 1 being the first unit in the station and carrying charges for equipment that will also be used by later units.

An interesting comparison is the 18% greater actual capability of Tuttle 1. Ratios based on this figure make an appreciable reduction in unit investment cost, as shown in Table 1. The same situation, however, holds at Leon Creek. This is not shown in Table 2; but unit costs based on actual capability will be well under $100 per kw placing them among the most economical plants in the U.S.A.

Unit 2 at Tuttle Plant will have a capability of 100,000 kw with estimated investment cost of $11,000,000. This unit is scheduled to start in April 1956. Another 100,000-kw unit is planned for operation in 1958; studies now under way will decide the location. Estimated peak load in 1957 runs about 367,000 kw.

The electric system is operated by a board of trustees, known as the City Public Service Board. W E Simpson is chairman of the board and V H Braunig is general manager.

# Nuclear notes

By B G A SKROTZKI, *Associate Editor*

**Total of 455,000 kw** in four plants has been proposed to AEC for their Power Demonstration Reactor Program. These are in addition to the 236,000-kw plant to be built by Consolidated Edison Co of N. Y. with its own funds, see p 81. All five atomic plants will have total investment of about $205,000,000. Details of the four plants and their builders are given below:

**Boiling-water reactor plant,** 180,000 kw, to be built by General Electric Co for Commonwealth Edison Co and Nuclear Power Group including: AG&E Service Corp, Bechtel Corp, Pacific Gas & Electric Co, Union Electric Co; will be completed by 1960.

**Light-water moderated and cooled plant** of 100,000-kw capacity will be completed in late 1957 by Yankee Atomic Electric Co of Boston. This company is made up of 12 utilities in the New England states.

**Fast-breeder reactor plant** of 100,000-kw capacity will be built in Detroit area to start in late 1958. Proposers include: Central Hudson G&E Corp, Cincinnati G&E Corp, Consumers Power Co, Delaware P&L Co, Detroit Edison, Long Island Lighting, Philadelphia Electric, Rochester G&E Corp, Toledo Edison Co.

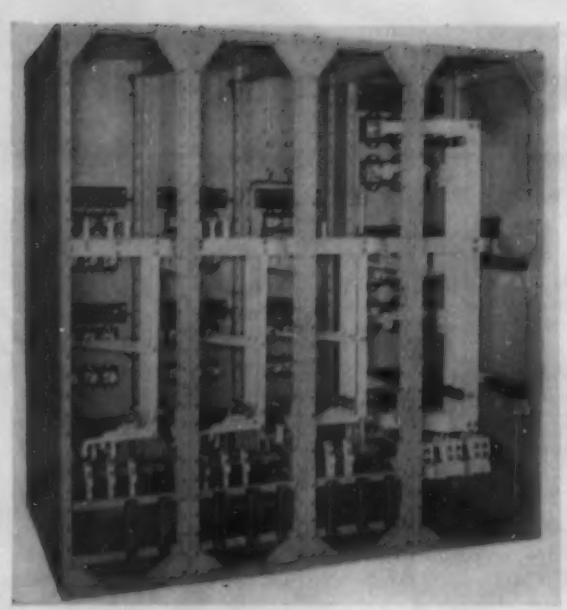
**Sodium-graphite reactor plant** of 75,000-kw capacity to be completed in 1959 by the Consumers Public Power District of Columbus, Nebraska. Each of these four proposals includes a provision that the government help to set up adequate insurance coverage beyond what can be obtained from private insurers.

**Zooming power rise** of over a million kw in 0.1 second blew up an experimental boiling-water reactor on July 22, 1954 at the National Reactor Testing Station in Idaho. Bright side of this result was that the experimental conditions were much more severe than would be expected in any "reasonably conceivable accident." A second boiling-water reactor started running at NRTS on Oct 19, 1954. This one runs at higher power and pressure, 6000 kw of heat and 300 psi.

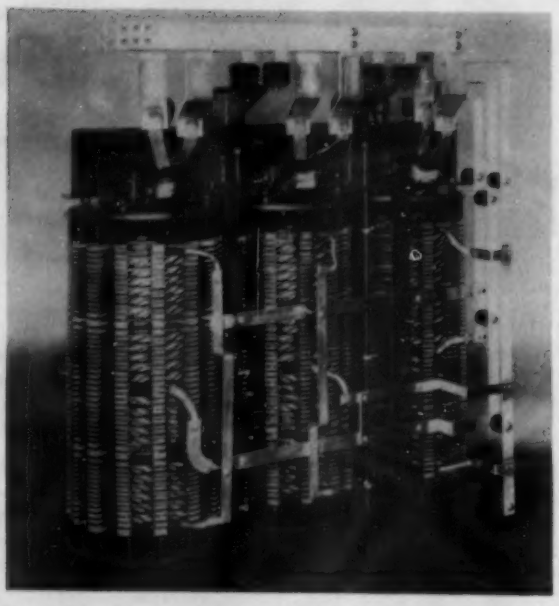
**Boiling-water power reactor** proposed for building by Argonne National Laboratory will produce about 20,000 kw of heat and 5000 kw electricity. The light-water moderated and cooled reactor and other equipment will be housed in a gas-tight steel shell with about 400,000-cu-ft volume. Fuel elements, mostly of natural uranium, will include a few enriched rods to give criticality. Allis-Chalmers and Sargent and Lundy, engaged on this project, hope to have unit running experimentally by end of 1956.

**AEC sets up Licensing Division** with Harold L Price as Director; the division will be responsible for preparing and administering the Commission regulations of licensing private activities under the Atomic Energy Act of 1954. Price formerly was Deputy General Counsel for the Commission.

**Nuclear boiler costs** as low as $80 per kw of capability have been estimated for plants with 75- to 150-mw capability, according to W K Davis of AEC. This includes the reactor with the first core. Comparable conventional boiler costs run about $40 to $70 per kw. "Reactor boiler" at Shippingport plant, Duquesne Light Co, is expected to average $620 per kw capability, first one of commercial size to be built.



Switchgear conductors and . . .



Transformer windings pinpointed as . . .

# Electrical spotlight focuses on aluminum

First national conference on electrical use of aluminum points out applications and problems of this light metal. Papers covered aluminum in cables and conductors, and as mechanical and structural components.

Sponsored by AIEE, conference was held in Pittsburgh, March 15-17, with 58 engineers on the program. Here's a quick summary of the major discussions on switchgear, transformers, distribution, and rotating machines.

## Switchgear

Aluminum's applications in switchgear vary from small rivets and hardware to important structural and current-carrying parts. Each takes advantage of some of the metal's characteristics. Electrical applications use its light weight and fair conductivity; mechanical and structural applications like cubicles and enclosures use the light weight, high strength-to-weight ratio, ease of fabrication, good machinability, corrosion resistance and availability. In high-current applications aluminum's nonmagnetic properties find wide use as bus barriers and housings.

Limitations include lower conductivity than copper, low annealing temperature, difficult joining problems, possible galvanic corrosion (see POWER, Aug 1954, p 107).

To get the best results with aluminum, you must select the proper alloy. The two general types are wrought and cast. Some are heat-treatable, others are not. Usually the designer selects alloys by the strength requirements of the part, although conductivity, resistance to corrosion, weldability, etc, must also be considered.

In both segregated and isolated-phase bus construction, aluminum is used successfully for both the enclosure and the conductor.

In substations, welded aluminum is often used for bus construction. It withstands high short circuits successfully. If properly designed it gives excellent service and may provide savings up to 35% in material and installation labor for major stations. In addition, number and variety of fittings is reduced; scope of possible troubles with defective nuts and bolts is cut down; welded joints are more permanent as well as electrically superior to bolted ones.

## Transformers

During and immediately after World War II, the copper shortage induced electrical manufacturers to try out aluminum windings. These windings proved satisfactory for both oil-insulated and dry-type distribution transformers.

Design and manufacturing experience with the oil-insulated type make it possible to convert from copper to aluminum windings. But core and coil proportions would have to be completely redesigned. Factory procedures would have to be modified to obtain the desired quality, maximum efficiency and performance. The final aluminum design could be very nearly the same as the equivalent copper design in weight and dimensions, and fully equal in performance. Such a change will not be made, however, until cost ratio or availability of materials makes it desirable.

Dry-type transformers can also be made with aluminum windings as manufacturing and design problems have been satisfactorily solved. You need larger coils and a bigger core, but this does not add greatly to the cost of the case required. As air is the principal insulator, a small increase in size of core and coils adds only slightly to insulation cost.

In addition, dry-type transformers are installed indoors. This eliminates the serious problem of aluminum-to-aluminum or aluminum-to-copper connections subjected to the weather.

Dry-type transformers with aluminum windings have been in successful service three to four years. But they cost about a third more than equivalent copper transformers. This makes the use of aluminum unlikely except in a copper shortage.

In addition, more work is needed on methods of joining aluminum to aluminum to speed up the manufacturing processes and reduce joining costs. Usually inert-gas shielded arc-welding methods are used. These are more critical and require more attention than the methods that are commonly employed in brazing copper to copper.

## Distribution

Experience of three utility companies using aluminum conductor indicates that it performs satisfactorily especially in light-load areas.

The material and construction cost is less than for copper conductors. These utilities have experienced difficulties with connectors, however. Common difficulties include (1) conductors burned down at connections (2) lights flickering because of loose connections or high-resistance connection caused by corrosion of the material (3) equipment damaged by unbalanced voltage caused by an open or poor connection in a secondary material.

Comparing ACSR (aluminum conductor, steel reinforced), with all-aluminum conductor of the same capacity, reveals that all-aluminum is justified not only for first cost of the conductor itself, but also for cost of material, labor, fittings and installation. On the all-aluminum, compression splicing sleeves cost less, can be installed faster, and sleeve centering is not so critical.

A study of nontension aluminum connectors at Texas College of Arts and Industries shows that (1) A joint can be made to carry current equivalent to that in a similar section of the conductor. (2) A contact aid (paste) must be used in any joint having one or more aluminum conductors. (3) Compression splices can be made uniformly with the proper tool. These splices are easy to cover and the contact aid can penetrate the joint better, especially with stranded conductors. (4) Aluminum connectors should be used on all connections having one or more aluminum conductors.

This last fact is borne out by a study conducted by Detroit Edison Company. Plated-bronze connectors for large all-aluminum conductors had developed trouble in the form of severe erosion of the wire under the connectors. Laboratory load-cycle testing showed that service failures were caused by arcing and burning resulting from loose bronze connectors. This was caused mainly by the differential in thermal expansion coefficients of the connector and the aluminum wire. But the more recently designed all-aluminum connectors performed excellently. In addition, the test ruled out electro-chemical corrosion between the metals as a cause of early failure in service.

## Rotating machines

Aluminum's properties make it peculiarly useful for rotating machines, whether fractional-hp motors or large turbine-generators.

Fractional-hp and integral hp applications include cast-aluminum cage in rotors; stators (for office machines and sewing machines); end shields for appliance motors; bearings, especially for one-bearing constructions; magnet wire for stator windings. For best results, aluminum windings must have designs different from copper windings. Motor performance with aluminum can be made equal to copper-wire performance.

In large turbine-generators, aluminum field windings permit an increase in the maximum rating using larger frames. Taking the largest possible air-cooled generator frame size as a base, adding hydrogen cooling at ½ psig extends the possible rating 20%. Using aluminum extends the maximum rating an additional 24%.

In armature windings, aluminum would require deeper slots to produce equal winding loss, thus increasing the machine diameter. The added space required is a serious limitation both for economy and for shipping. It's unlikely that aluminum will be used for armature windings unless there is a severe copper shortage.

In nonelectrical applications, aluminum alloy has been used for generator terminal plates; coil slot wedges; cooling fans for hydrogen-cooled units; doors and panels on lagging and housing.

The future may see hollow extruded-aluminum field windings; aluminum cooler tubes, fins and tube sheets in hydrogen heat exchangers and fabricated aluminum stator frames.

By J M CHAMBLISS
*Mechanical Engineer*
*Niagara Mohawk Power Corporation*

**DUNKIRK STEAM STATION'S** modern coal-handling system has potential dust-raising points at *car dumper, left, breaker house, center, junction house, right*

# Spraying wipes out coal-dust troubles

**Albany and Dunkirk Stations of Niagara Mohawk Power Corporation burn coal only—about 1,340,000 tons yearly. Danger and nuisance of coal dust demand using an effective control**

► THERE ARE six steam stations of Niagara Mohawk Power Corporation in New York State at Albany, Amsterdam, Oswego, Utica, Dunkirk and Buffalo. These have a total installed capacity of about 1960 mw. The most recent are Albany Steam Station, four 100-mw units, last unit completed in 1954, and Dunkirk Steam Station, two 100-mw units, completed in 1950.

**Dust problems.** These plants burn coal exclusively, for the most part of "pulverized-fuel" type with a high percentage of fines. At times the coal is very dry and dusty. We have given much study to the control of dust in our coal-handling systems.

Hazards of coal dust include: (1) possibility of explosion and fire under certain conditions (2) respiratory disorders and discomfort to operators (3) adverse effect on operation and maintenance of equipment (4) loss of coal by blowing away in open areas (5) nuisance to neighbors of coal-dust clouds, which may settle over large areas.

We made studies of various methods to control dust by: (1) buying special coals (2) treatment with oil (3) treatment with calcium chloride (4) spraying with water mixed with a wetting agent (5) tighter enclosure at transfer points (6) dust removal by suction through blower system and dust collectors. We even considered converting to oil burning on some older boilers because certain advantages included eliminating coal dust.

Spraying a mixture of water and wetting agent proved the most practical with lowest over-all cost. Water alone does not mix readily with dusty coal. At times large amounts of water would be needed. The wetting agent reduces the surface tension of the water and so less water wets down a given amount of coal.

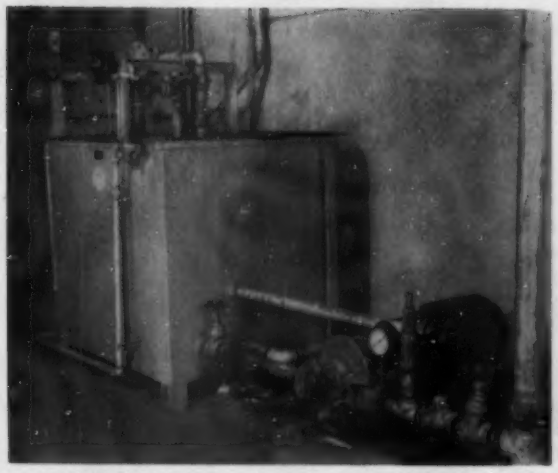
We have been wetting down coal with water and a wetting agent for some years at Oswego (400 mw) and C R Huntley Station in Buffalo (800 mw). This has been reasonably effective. At Dunkirk and Albany, we installed more complete dust-control systems, also using water mixed with a wetting agent. These systems have practically eliminated the coal-dust problem.

**Coal-handling systems** at Albany and Dunkirk are similar, with design capacities of 750 tph. Albany burns about 900,000 tons yearly and Dunkirk about 440,000 tons. All coal comes from West Virginia and Pennsylvania mines by rail. Coals used range from run-of-mine to "pulverized fuel," size ¾ in. and smaller.

Moisture as received varies from 2 to 14%. A typical coal analysis is:

| | |
|---|---|
| Fixed carbon | 53.5% |
| Volatile | 31.5% |
| Moisture | 5.0% |
| Ash | 10.0% |
| Sulfur | 2.0% |
| Heat content, as fired | 13,100 Btu per lb |
| Ash-softening temp | 2050 F |
| Ash-liquid temp | 2500 F |
| Grindability, hardgrove | 65 |

Rotary-type car unloaders dump coal cars over a receiving hopper with two outlets. Two lump crushers under the hopper outlets reduce lumps to about 6 in. maximum. Two pan feeders pass the coal to two successive belt conveyors. These elevate the coal so it goes

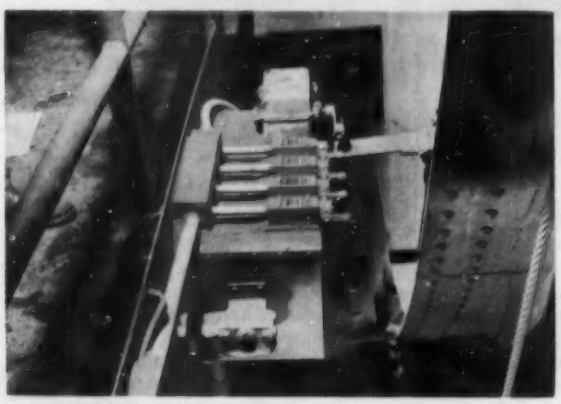


**PROPORTIONER UNIT** has 2-section tank to hold concentrated wetting compound and the solution. Ejector mixes solution

**CAR-DUMPER HOPPER** has two sets of sprays. This header runs along one side of hopper and part of ends to spray coal

**TOP SPRAY HEADER** rides on car dumper to wet coal as it becomes uncovered during dumping operation, prevents dusting

**LOWER SPRAY HEADER** alongside car-dumper hopper covers coal from side opposite to the header shown in picture above



**LIMIT SWITCHES** at car dumper end ring operate solenoid-controlled valves to automatically turn water sprays on and off

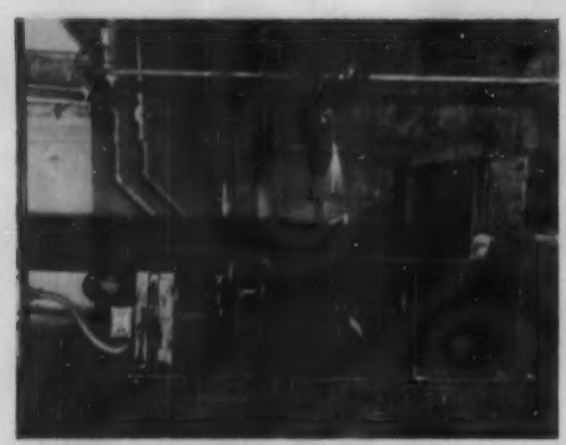
**CONVEYOR BELOW CAR DUMPER** is the first belt carrier in station to be sprayed automatically as needed at feed end

to either (1) a Bradford breaker and on to the main plant or (2) a boom conveyor with a telescopic chute for delivery to storage.

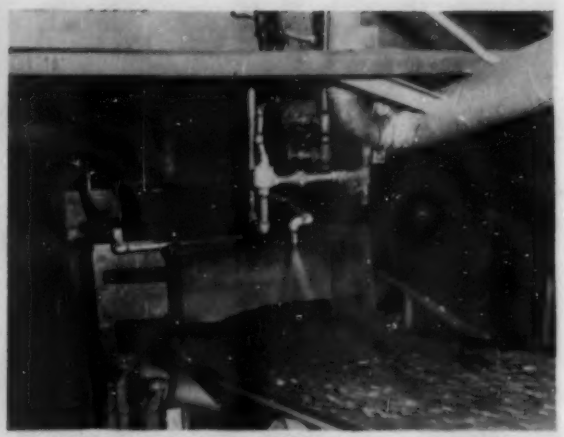
The Bradford breaker screens and reduces lump size to 1¼ in. maximum. From the breaker the coal drops on a collector belt discharging to two successive conveyors, which carry it to the first overhead bunker inside the plant. This conveyor may also discharge to another conveyor leading to a second bunker inside the station.

At Albany, with four generating units, there are two additional conveyors in series serving two additional bunkers. Each bunker has a capacity of 1100 tons, about a 36-hr supply of coal.

Bulldozers reclaim coal from the storage pile to a reclaiming hopper. A pan feeder and an underground conveyor



**RECLAIMING CONVEYOR** has coal sprayed at feed end just beyond hopper. Nozzle control unit, *left*, regulates spray



**CONVEYOR AT BREAKER DISCHARGE** carries increased fines that may aggravate dusting—spray helps to control nuisance

**AUTOMATIC NOZZLE-CONTROL UNIT** has microswitch that is actuated by spring-loaded wheel riding underside of belt

discharge onto the conveyor under the car dumper and so onto the main system, just described.

Normally we buy coal at the rate we burn it. Cars are dumped during the normal working day, five days per week, and the bunkers supplied as needed. Coal going to storage is reclaimed during week ends and as needed.

**Dust-control system** for Dunkirk and Albany plants, consists of a proportioner unit automatically supplying the needed amount of solution of water and a wetting agent, an electrically driven pump delivering solution through header systems to spray points, spray nozzles with automatic controls at various points in the coal-handling system.

To make the solution, one part of the wetting agent — Compound M-R — is mixed with 750 parts of water.

**Car dumper** is the first coal-transfer point in the station. One row of spray nozzles hang over the car while it is on the dumper. Swivel joints connect the spray header to the supply piping so the header and nozzles can ride on the dumper while it rotates. Limit switches on the dumper automatically control the spray nozzles through solenoid valves. These nozzles spray the coal during the part of the rotation when coal falls from the car.

Two other headers feeding and supporting nozzles run along the two sides at the top of the receiving hopper. These extend partly along the ends as well. Limit switches also control these nozzles to spray during the greater part of the dumper rotation.

The three sets of sprays form a mist blanket that mixes evenly with the coal as it dumps and prevents dust from escaping. Total quantity of solution used for a car of 60 tons is about 110 gallons.

**Second spray point** is below the dumper where the coal leaves the two lump breakers and falls onto the first conveyor. The crushers produce more fines that may raise dust. Sprays over the pan feeders wet down the coal from the lump breakers at this point.

Once turned on by the operator, these sprays work automatically, regulated by a nozzle-control unit under the conveyor belt that responds to the weight of coal on the belt. A microswitch on the unit closes when the belt carries a normal amount of coal. This turns on a solenoid valve to feed solution to the spray nozzles. This prevents spraying an empty or partly loaded belt.

Electrically interlocking the control with the belt-drive motor circuit prevents spraying when the belt is shut down. These nozzles pass about 10 gpm of solution.

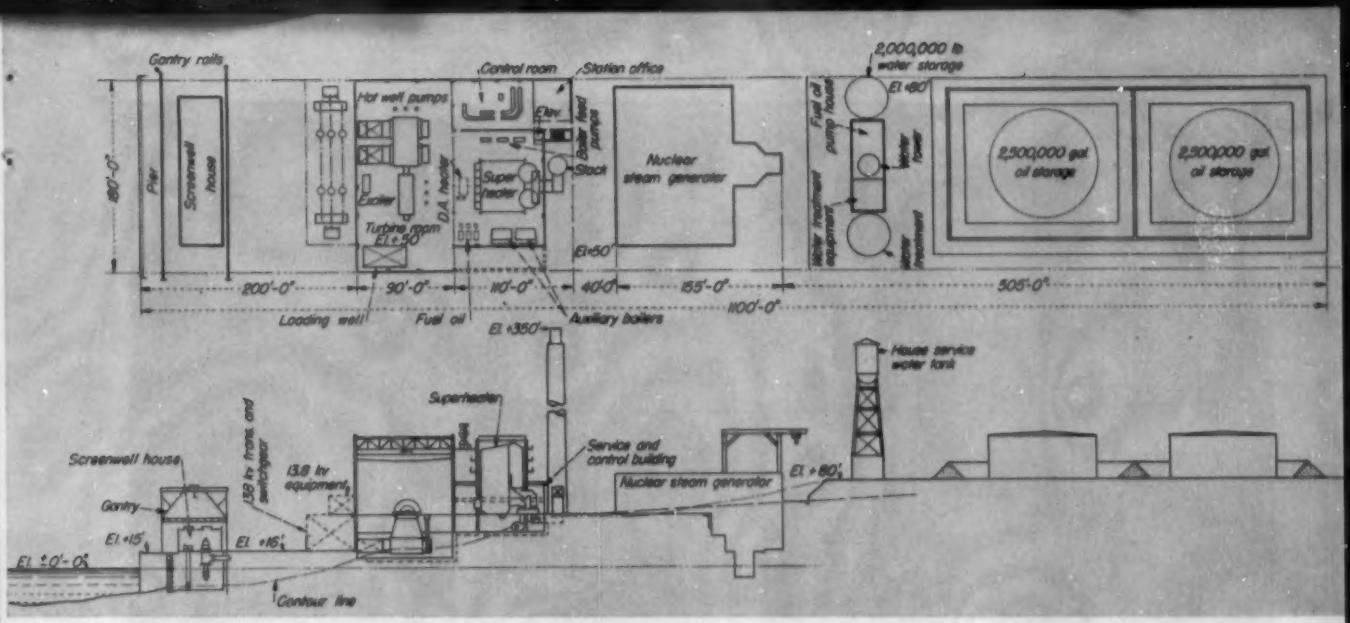
No other sprays are used in the conveyor system from the car dumper to the Bradford breaker or to the storage pile. The dust stays under control at the conveyor transfer points between these two locations.

**The third spray point** works at the Bradford breaker discharge. The breaker produces additional fines and dust that must be wet down. Similar sprays and controls are used here as at the car dumper feeders. No other spraying is needed beyond this point on the way to the main storage bunkers.

The reclaiming hopper uses a fourth spray point. These sprays are only used during reclaiming when the car dumper does not run.

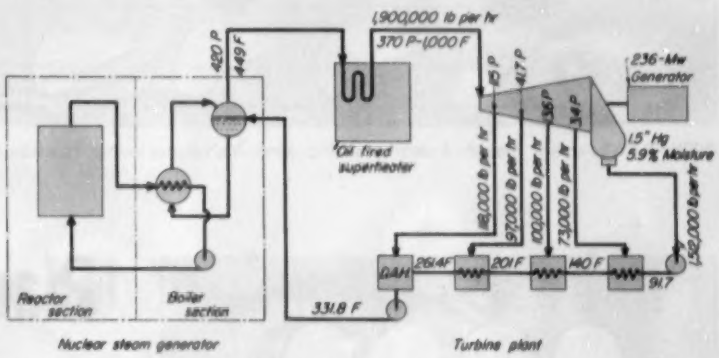
The maximum amount of solution (moisture) added to the coal when dumping cars with all sprays running is about 3½ gal per ton, under 1½%.

(*Continued on page* 202)




**INDIAN POINT STATION** on eastern shore of Hudson River, 24 miles north of New York City, will occupy 350-acre site. Ground will probably be broken during summer of 1956 in preparing for 3-year construction program; no government aid

**Consolidated Edison of N. Y. appropriates $55 million for first privately financed nuclear-fired power plant. Expected to 'go critical' in fall of 1959, new plant . . .**




**PRESSURIZED-WATER** uranium-thorium converter reactor generates saturated steam at 420 psia. Oil-fired superheater boosts steam throttle temperature to 1000 F

# Teams up fissioning with oil burning

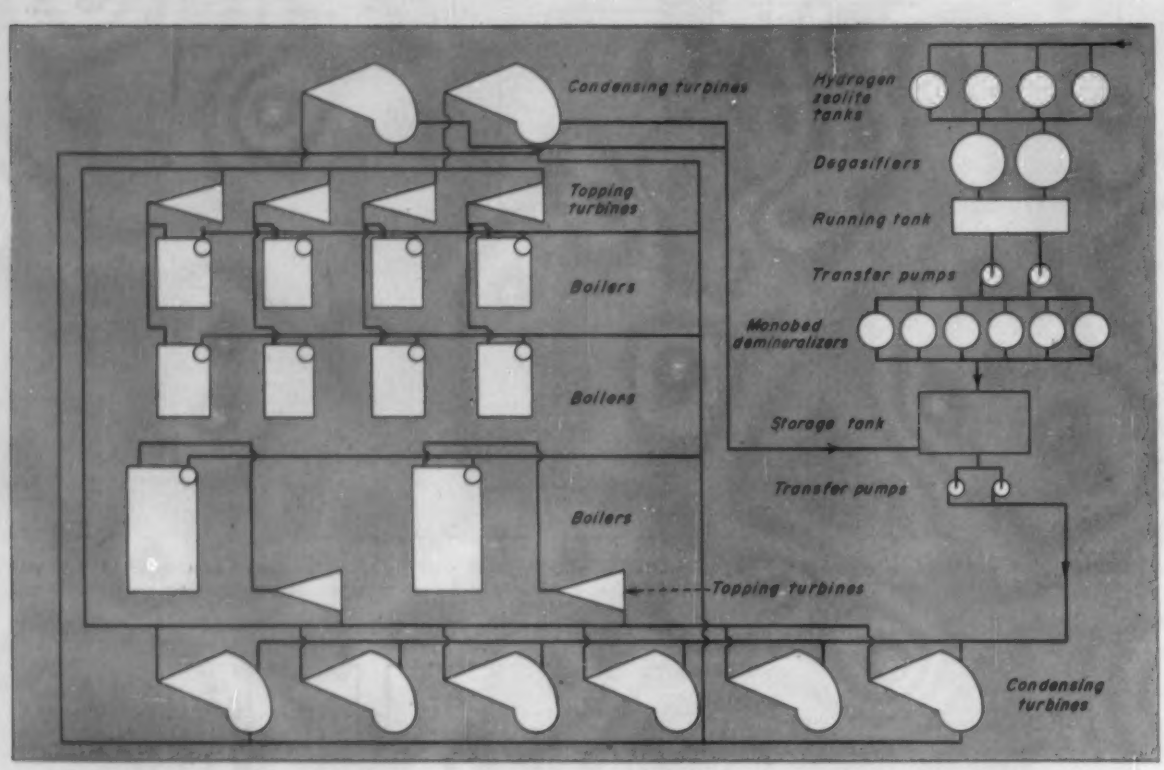
► On March 25, 1955, Consolidated Edison Co of N. Y. filed a license application with the Atomic Energy Commission. The new Indian Point Plant will be built in Buchanan, N. Y., without government aid. General Electric Co, Westinghouse Electric Corp and Babcock and Wilcox Co were asked to submit proposals for complete nuclear steam generators of about 100- to 200-mw electric capacity. The design by B&W was chosen; it promises installation and operating costs that compare reasonably with conventional fuel-fired plants.

**Nuclear steam generator** consists of a pressurized-water uranium-thorium converter reactor and four boilers. A large steel cylindrical vertical tank, partly filled with shielding water, holds a small vessel containing the reactor core. Closely spaced fuel elements in a geometrical pattern make up the reactor core. Enriched uranium serves as the basic fuel, but uranium-233 obtained from conversion of thorium-232 in the reactor also supplies heat by fissioning.

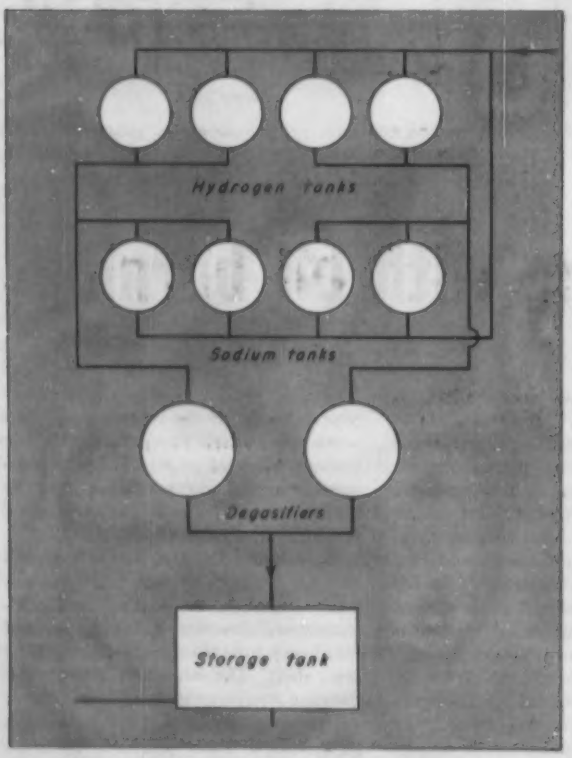
Corrosion-resistant material protects the fuel elements and prevents the coolant water flowing over them from becoming contaminated with radioactive fission products. Control rods interspaced within the fuel element will be positioned by remote control through hydraulic or electrical systems. Four pipe loops from the reactor core each serve one boiler. Pumps circulate the coolant water at about 1500-psia pressure through the loops. Steam from the boilers enters a steam header leading to an oil-fired superheater.

**Each boiler** has two major components, a boiling section and separate steam drum. In the boiling section U-shaped stainless-steel tubes are welded into heavy tube sheets, all enclosed in a steel shell. The coolant flows through the tube interiors. Steam from the water surrounding the U tubes rises through pipes to the steam drums to be dried

(*Continued on page* 200)




**NEW PLANT,** right. Monobed demineralizing gives high-purity water. District heating uses 30% of the topping units' steam



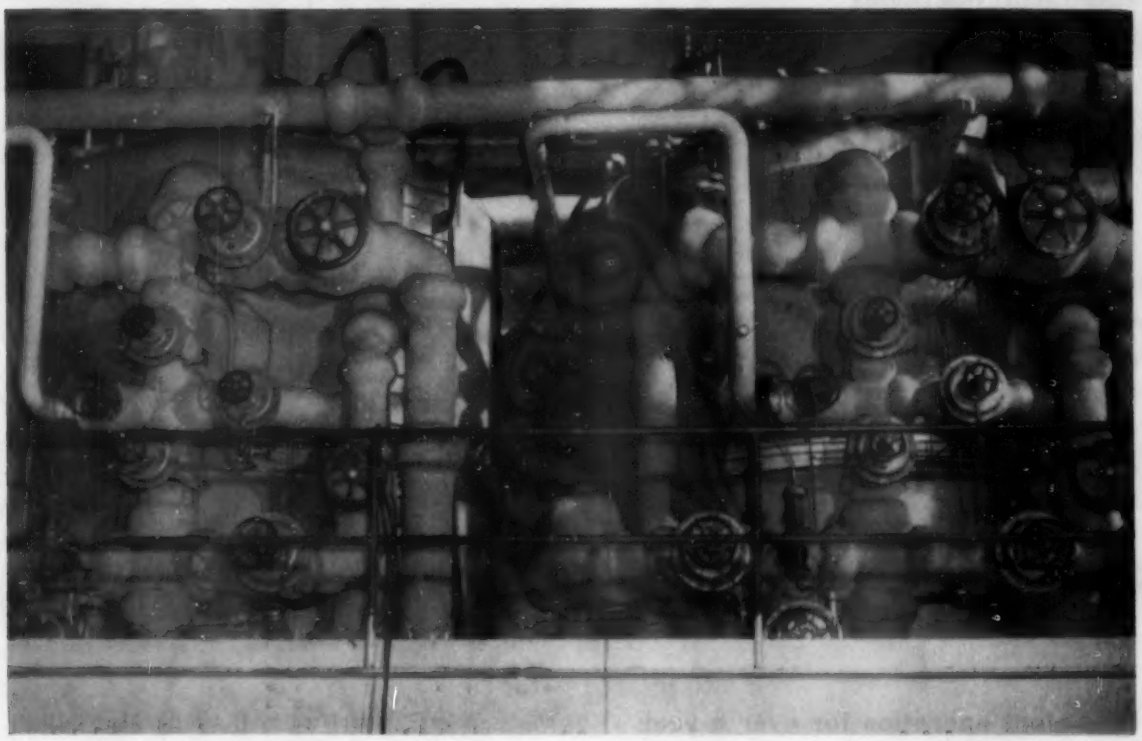

**OLD PLANT,** hydrogen-sodium zeolite: Silica left untouched

# Plant attacks silica

**Con Edison's Waterside Station is a 100% high-pressure plant—and makeup rate runs about 40%. Silica control is a must.**

**Handicaps of the original feedwater-treatment plant, *left*, and blowdown rate of 6 to 8% resulted in turbine silica fouling. After much search, the monobed plant, *above*, was chosen to solve the silica problem***

By I B DICK, *Assistant Chief Chemical Engineer*
*Consolidated Edison Company of New York, Inc*



**NEW MIXED-BED UNITS** mounted on platform above turbine-room floor. Operation fully automatic except regeneration startup

# problem with monobed demineralization

► WE HAD a very severe turbine silica-fouling problem at our Waterside Station. And the losses caused by the fouling justified considerable investment to eliminate this problem.

Waterside has ten boilers, rated from 500,000 to 1,000,000 lb per hr at 1400- to 1710-psig drum pressure, 950-F steam pressure. Total evaporation is 6,460,000 lb per hr. All steam passes through six topping turbines and discharges at 200 psig (see diagram, top, facing page). As much as 1,800,000 lb per hr of this 200-psig steam is sold for district heating. The rest is used for feedwater heating, operating-station auxiliaries and driving eight condensing turbines. So makeup due to steam sales alone can be nearly 30%.

This makeup, until recently, came from hydrogen-sodium zeolite softener consisting of four 11-ft-diameter sodium-zeolite units, four 12-ft-diameter hydrogen-zeolite units, and two decarbonators. The softened makeup was deaerated in condensers, where it entered the feedwater cycle on mixing with main condensate.

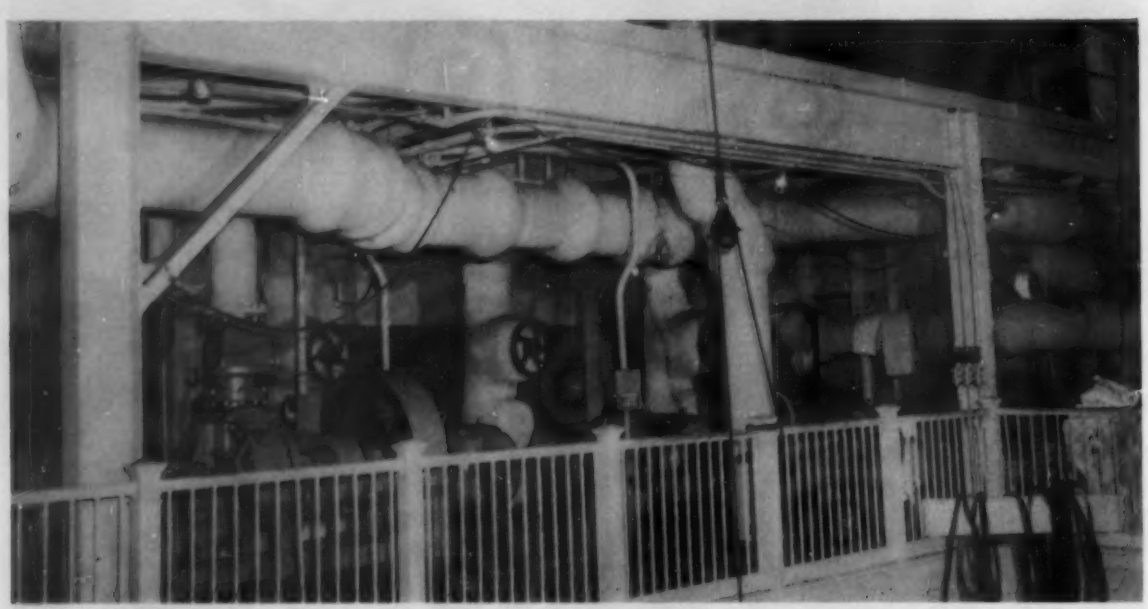
Raw water is obtained from New York City's Croton and Catskill supplies, which normally have silica contents of 6.3 and 2.4 ppm, respectively. To keep total dissolved solids around 300 ppm required 6 to 8% continuous blowdown. When this is added to makeup, and soot blowing and incidental losses are also included, makeup needed approaches 40%. With Croton water, and with blowdown and makeup given, simple arithmetic shows that expected silica concentrations would be about 30 to 35 ppm. That's what we were getting in the past years.

At this high level, silica fouling of turbines was excessive and caustic washing frequent. Each condensing turbine was washed every 4 to 6 weeks. Losses involved were: reduced turbine efficiency; reduced turbine capacity; outage time for washing; labor and materials for caustic washing; boiler blowdown losses, including heat, water and chemicals. Analysis of these losses showed it was worthwhile to make a large investment to eliminate the fouling and to reduce blowdown.

**Search for silica remover.** Since it is impractical to evaporate as much makeup as we needed, silica removal by demineralization was our only hope. Before strong-base anion-exchange resins came into the picture, we tried a test unit that used hydrofluoric acid or sodium fluoride to ionize silica so it could be removed by the weak-base anion resins then available. Extended experiments proved this 1-foot 2-bed package unit quite successful. But the process was expensive without fluorine recovery—and complicated if recovery was used.

By the time experiments on this unit were complete, strong-base anion resins had begun to appear. We entered briefly into very early pilot-plant tests, but the

*Adapted from paper presented at the Fifteenth Annual Water Conference of the Engineers' Society of Western Pennsylvania



**TRANSFER PUMPS,** air compressors. Lower portion of decarbonator is seen, *top, right.* Pumps send water to demineralizers

## Pilot-plant operation for over a year proved invaluable in setting up big plant

process at that time was not a commercial success. Consequently, we decided to wait for its perfection.

Successful silica removal came with the 2-bed demineralizer, using strong-base anion resins. So we made a study of this process. But space requirements for large number of cation and anion tanks, decarbonators, running tanks and transfer pumps ruled out such an installation at our station. Also, costs in our case rendered it a questionable investment.

Meanwhile, development of the monobed demineralizer interested us, primarily because it might be possible to install such a system in available space. After much study, we purchased a monobed plant consisting of six 11-ft-diameter units rated at 5000 gpm for continuous operation.

Flow diagram of new water-treatment plant is shown at top of p 82. Four hydrogen-zeolite tanks were retained from old zeolite plant, bottom p 82. Raw water goes first to hydrogen-zeolite tanks, and softened water at pH of about 3.5 is then decarbonated. Transfer pumps pick up water from rubber-lined running tanks and send it through the monobed units. Storage tank is bitumastic lined. Condensers deaerate.

We have kept the hydrogen tanks in service. Among our reasons are: (1) They act as filters to keep suspended solids from raw water out of monobed units. (2) They keep calcium out of monobed units. Since our water is largely a calcium bicarbonate hardness water, the cation resin is particularly subject to calcium sulfate fouling on regeneration. (3) They remove bicarbonate by decarbonation rather than by anion exchange. The hydrogen units are not meant to do a complete cation-removal job. Experiments are still in progress to see how low we can go in regenerant level to permit some cation slippage without impairing primary objectives of the cation operation.

**Pilot plant.** Having purchased the monobed plant, we still had to make several major decisions. To get information for these decisions, we installed a small, commercial monobed unit to be operated on our water under the exact same conditions as for the big plant. This pilot unit ran for a year and a half before the big units went into operation, giving us valuable information.

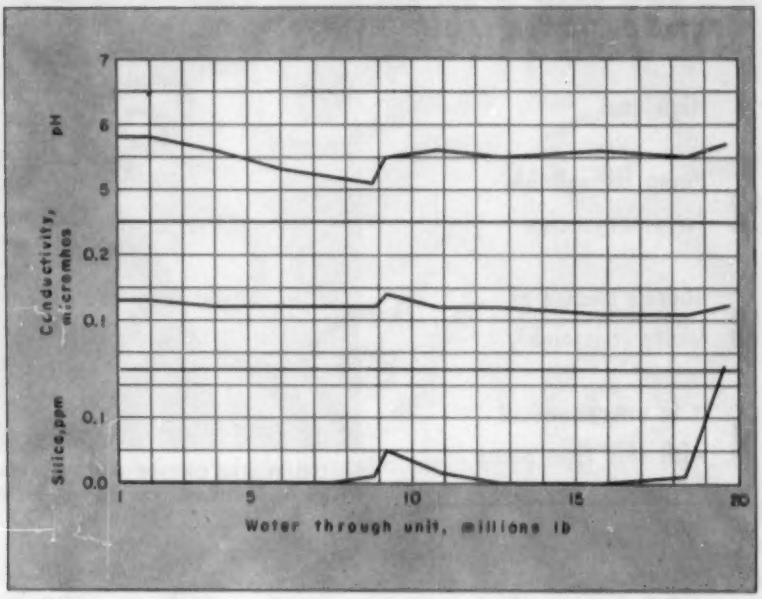
As first assembled, the pilot mixed-bed unit contained IR-120 and IRA-400. The IRA-400 resin failed to meet specifications almost immediately. It was replaced by IRA-401 at the supplier's recommendation. So far, this material seems completely satisfactory — after over 100 cycles in the pilot plant, no significant loss in anion capacity is apparent.

Pilot plant experience brought out some interesting angles. Something in the raw water occasionally interfered with the operation of the anion resin. We ran many tests to find out what the material was—the information obtained is too extensive to treat here (see POWER, July 1954, p 76).

But here are some of the findings as they affect the big plant: (1) Special regeneration procedures are needed to remove substances fouling anion resin. (2) Conductivity does not always go up sharply before silica increases from the monobed outlet. So silica tests are needed. (3) Photoelectric colorimeters simple and rugged enough for use in the field—are not sensitive enough for low silica concentrations. (4) Low-level regeneration of cation units apparently does not give some cation slippage—instead, unit merely takes out all cations over a shorter period of time.

We assembled our own photoelectric colorimeter to solve the sensitivity problem (see photo, top left, facing page). The important feature is that light passes downward through a long column of water. 95% transmittance corresponds to 0.01 ppm $SiO_2$—this compares favorably with calibration on much more expensive and delicate laboratory instruments. This device is very

**PHOTOELECTRIC** colorimeter for silica




**TYPICAL MONOBED RUN:** effluent quality for one unit: Note the low conductivity

simple and durable and can be used by plant operators.

**In the big plant,** units are charged with a mixture of one-third IR-120 and two-thirds IRA-401. Each tank contains 492 cu ft of this mixture amounting to a 5-ft depth of bed. All tanks, valves and piping are rubber lined, and all tank internals are of special acid-resistant bronze, stainless steel, or plastic. Regeneration is started manually—otherwise, operation is fully automatic. Had conductivity been found to break before silica, regeneration startup would have been automatic too.

Probes are above the bottom of the monobed unit. It is possible that, by experimenting with the settings, a reliable conductivity break can be obtained. If so, we can make controls fully automatic at some future date.

Since each unit will eventually have to produce 1000 gpm of treated water, we try to operate each one close to this figure. As water demand falls, we shut off units to keep operating units more fully loaded. Contrary to cation softeners, these monobed units apparently can be taken off line and returned without impairing water quality.

The units went on the line almost too easily. Things went so smoothly that we suspected something would go wrong. But they carried full load right from the beginning and gave water of fantastic purity. A few mechanical difficulties cropped up and were corrected—otherwise, operation has been most successful. Separation, regeneration and remixing of the beds has been excellent.

**Results.** Graph at top shows quality of effluent water from a typical run on one unit. The pH starts and ends at about 5.8—this is characteristic of monobed operation on New York City water. In spite of this low pH, conductivity is excellent. Silica figure is our control point since our operation is primarily for boiler-water silica control. Sharp break in silica contrasts markedly from slight break in pH and conductivity.

**Regeneration.** Total time for regeneration of each unit is 233 minutes. Breakdown of cycle in minutes is: initial drain—18; backwash—21; settle—2; acid injection—55; caustic injection—90 (acid and caustic injection are done at the same time); slow rinse—35; drain—18; mix—18; blowdown—8; fill—18; settle—2; final rinse—3. Time of just under four hours may be reduced some with experience. Separation and remixing of beds is especially gratifying.

Process water for regeneration amounts to only a little over one percent of the treated water produced on a run. Chemicals for regeneration are: acids—8.3 lb of 66 Baumé $H_2SO_4$ per cu ft of cation resin; caustic—9 lb NaOH per cu ft of anion resin during early stage of operation, reduced later to 8 lb. We hope to reduce this to 6 lb when we gain experience with hot caustic operation. Although we believe quantities of regenerant chemicals are excessive and will ultimately be reduced, cost of monobed operation is running $10.00 per million pounds of water treated—this includes only chemical and process-water costs.

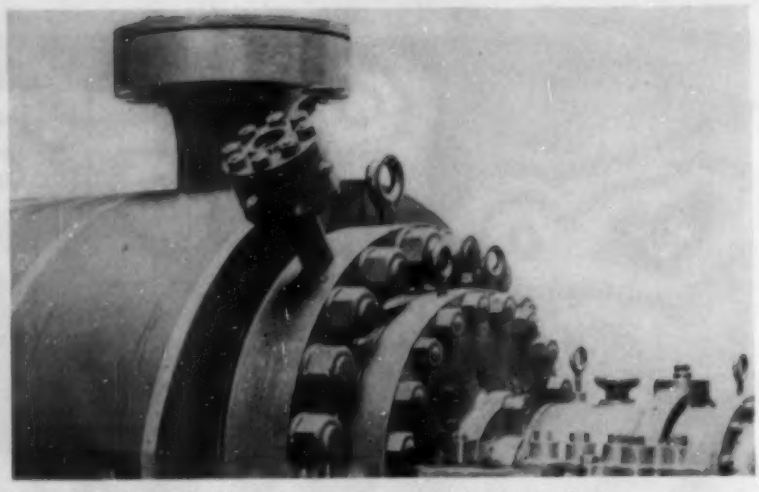
**Effect on system.** It was of great interest to follow the effect of demineralized water in boilers and other parts of the system. Silica in boilers dropped conspicuously in the first half day and thereafter tended to level off or to coast very gradually and slowly down. Total dissolved solids did the same and continuous blowdown was reduced to 2%—sometimes blowdown was cut off altogether when dissolved solids threatened to vanish except for added chemical treatment.

We know that boiler deposits in this station consist mostly of iron oxide and copper, but they frequently contain widely distributed silica-bearing compounds, from traces to a few percent. Failure of the silica to drop faster to lower levels may be due to redissolution of some of this deposited silica. But silica in the boilers generally got down to about 5 ppm—this should just about stop silica carryover to the turbines. Silica has continued to drop and will level off at about 2 ppm. Turbine fouling has decreased markedly, but we have not yet had a chance to clean up all the old deposits.

There are a lot of things about anion resins that we do not know. And where information is lacking on operation with a particular water, we strongly recommend that anyone contemplating a monobed plant put in a pilot plant. We feel it prepared us for any eventuality.

**FOUR REASONS AGAINST PERIODIC OVERHAULS**

1. High cost
2. Pump unavailable for emergencies
3. There's chance of faulty reassembly
4. It is uneconomical with this type pump



**1** **CALIBRATED ORIFICE** on this barrel-type centrifugal boiler-feed pump is used to measure leakage past balancing device, indicates degree of internal leakage

# How often should you overhaul your

By IGOR J KARASSIK and T W EDWARDS
*Centrifugal Pump Div, Worthington Corporation*

► WHILE PUMP OPERATORS have long argued over the advisability of opening feed pumps at regular intervals for inspection and overhaul, pump designers are almost unanimously united in believing there is no advantage gained until performance shows a maintenance need.

**Modern designs.** Table, above left, shows four good reasons against periodic overhauls—cost, availability, damage and poor economy. Modern designs and materials-selection practices are primarily directed at lengthening the time between shutdowns for overhaul and maintenance.

Higher investment for equipment, keynoted by greater use of stainless-steel alloys, would make it extremely uneconomical to subject these units to unnecessary overhauls, if they were chosen to run for extended periods.

**Schedules.** The cardinal principle in scheduling complete overhauls is that a centrifugal boiler-feed pump need not be opened for inspection unless (1) factual or (2) circumstantial evidence indicates it is necessary. There is but one exception to this rule.

Factual evidence constitutes (1) a fall-off in pump performance justifying the expense of an overhaul (2) pump noise (3) driver overload indicating trouble (4) excessive pump vibration. In extreme cases, the pump may have seized at the internal clearances as a result of foreign matter, overheating or a mechanical defect.

Circumstantial evidence is accumulated from past experience with a particular pump or from similar equipment on the same service. For example, if a group of chromium stainless-steel alloy pumps run 60,000 hr continuously without needing a complete overhaul, an additional duplicate unit can be run for the same period.

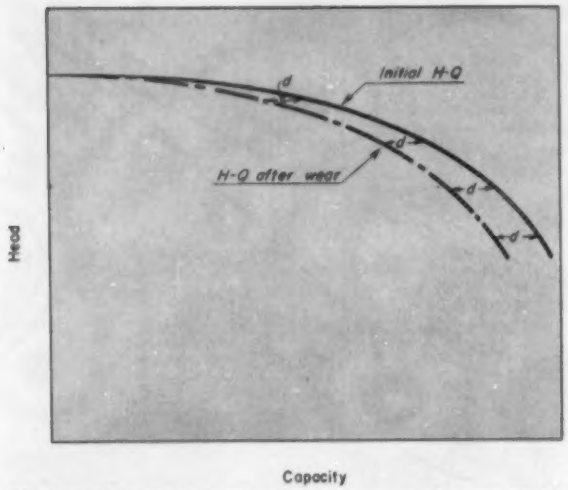
**Exception.** This rule does not hold for corrosion-erosion troubles. These are rare, however, because much attention has been devoted in recent years to proper materials for high-pressure high-temperature boiler feed pumps. Today, 5% chrome stainless casings and 13%, or higher, chrome stainless fittings are established practice for all feed pumps serving 850-psi and higher-pressure plants. The practice is beginning to spread to plants operating at lower pressures.

But since ordinary materials (cast iron for casings, bronze for fittings) are still used in many low- and medium-pressure plants, corrosion-erosion troubles are still a potential danger. So when pumps of these less-resistant materials are used with feedwater that may cause severe and rapid deterioration, it is advisable to open the unit for inspection soon after initial operation. It should also be opened at intervals thereafter to establish an experience pattern that proves the equipment is satisfactory for its job.

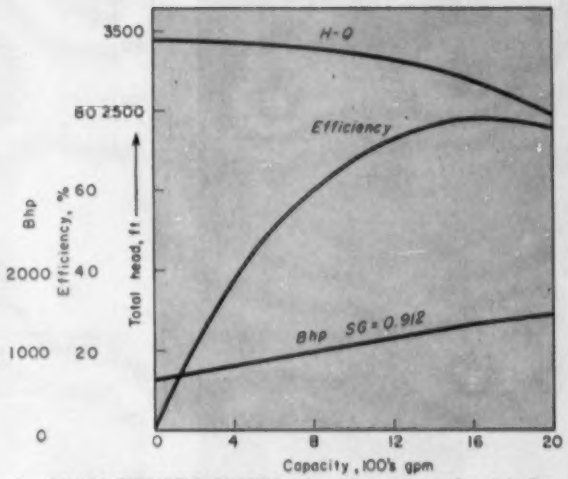
**Causes of wear.** Erosive action of the water flowing past wearing rings and interstage bushings causes part of the wear at all internal clearance joints. Another portion is due to infrequent momentary contacts, which occur on relatively rare occasions during pump operation.

No matter how rigidly a pump is designed, certain conditions arise during transient loads (partial cavitation or similar sudden hydraulic impacts) that impose a temporary vibration on the rotating element sufficient to cause a slight momentary contact at the running joints.

This contact may not be enough to cause permanent damage or seizing, but it does affect the running clearances. A similar condition may exist if the shaft deflection under stationary condi-




**2** **EFFECT OF WEAR** on head-capacity curve of a centrifugal boiler-feed pump. Leakage is nearly constant at all heads




**3** **CHARACTERISTIC CURVES** of a typical centrifugal boiler-feed pump, which is rated at 1645 gpm with a 2840-ft head

# centrifugal boiler-feed pumps?

tions exceeds the existing clearances. This can occur even though the deflection is reduced to less than the running clearance by the supportive effect of internal clearance joints acting as additional steadying bearings. In these cases a slight amount of wear occurs every time the pump starts.

It is impossible to state the exact amount of wear attributable to erosion or to momentary contact. But the more rigid the pump construction, the less the effect of transient conditions on wear of the running joints.

Varying wear in exactly similar pumps operating under apparently similar conditions indicates existence of a varying frequency of transient conditions and vibrations.

**Effect of wear.** As running clearances increase with wear, a greater portion of the gross capacity of the pump is short-circuited through the clearances to a lower-pressure stage. The effective or net capacity delivered by the pump against a given head is reduced by an amount equal to the leakage increase.

While in theory the leakage varies with the square root of the total head, it is sufficiently accurate to assume the leakage increase remains the same at all heads. Fig. 2 shows the effect of increased leakage on the shape of the head-capacity curve. Subtracting the additional internal leakage $d$ from the initial capacity at each head in the pump range gives a new head-capacity curve, as shown in Fig. 2.

**Performance.** If the pump whose characteristics are shown in Fig. 3 delivers, when new, 1645 gpm against a 2840-ft head, while absorbing 1370 hp when handling 314-F water at an efficiency of 78%, let's see what an increase in internal leakage of 2% of the initial capacity will do to performance.

With increased leakage the pump delivers 1610 gpm against the same head and requires the same power input. Efficiency is reduced by the ratio of the initial capacity to the present capacity, or to 76.5%. At the original capacity, 1645 gpm, the pump now develops a 2825-ft head at 77% efficiency.

Since a capacity margin is always provided in feed-pump design, the unit in Fig. 3 may normally be required to discharge only 1480 gpm at 2840-ft head, with the excess pressure throttled by the feedwater regulator if the pump operates at constant speed. So the additional leakage does not impair normal performance. The decision to overhaul the pump at this point depends solely upon evaluating the reduced economy against the cost of the overhaul.

In high-pressure feed-pump operation it is good practice to renew internal clearances when the leakage doubles. At this point the added power to meet station loads becomes appreciable and usually justifies the overhaul cost.

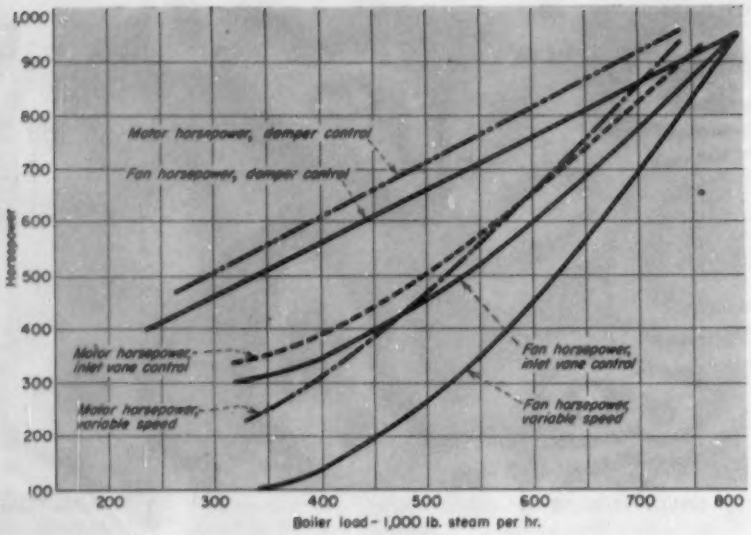
**Performance tests.** An accurate test of the pump head-capacity curve gives a reasonable indication of the internal condition. Proper instrumentation for determining pump capacity and pressure is a must, both for routine operation and for tests.

A rigid schedule should be set up for pump head-capacity tests so the performance can be compared with the original values when the unit was new. This comparison, not the mere passage of a certain time interval, should establish the degree of internal wear and the need for an overhaul. Tests, which are cheaper than overhauls, can be made without taking the unit out of service.

Power-consumption increase for a given flow rate, change in pressure drop across the feed regulator and speed measurements on variable-speed units are approximate means of determining performance when full head-capacity tests cannot be made or are not accurate enough.

**Measuring leakage.** A calibrated orifice, Fig. 1, fitted with a differential pressure gage or manometer can be installed in the balancing-device leakoff line if the leakage is returned through external piping. By inference, the orifice readings can give an accurate indi-

(*Continued on page 208*)




**HORSEPOWER NEEDED** to drive i-d fan using different control methods. Boiler is rated at 650,000 lb per hr. Variable-speed controls show greatest power saving

# How to select f-d, i-d fans

**Fan-design conditions depend on a variety of items—firing method, steam load, flow controls, chance of fan erosion, to mention just a few. Here's a study of key points to help you choose the right draft fan for your plant**

**FIRST OF TWO ARTICLES**

By **GEORGE A EATON** and **ROBERT H SHANNON**
*United Engineers and Constructors Inc*

► GETTING ECONOMICAL, efficient operation from today's high-pressure high-temperature steam generator depends—in large measure—on careful design and selection of auxiliary equipment. Engineers tackle one of the most important of these auxiliaries when they are called on to select mechanical-draft fans. Picking the right fan depends as much on sound judgment as it does on the use of hard and fast formulas. In this first of two articles we're going to discuss key factors affecting choice of fans as well as their controls. In an upcoming article we'll work out a specific case.

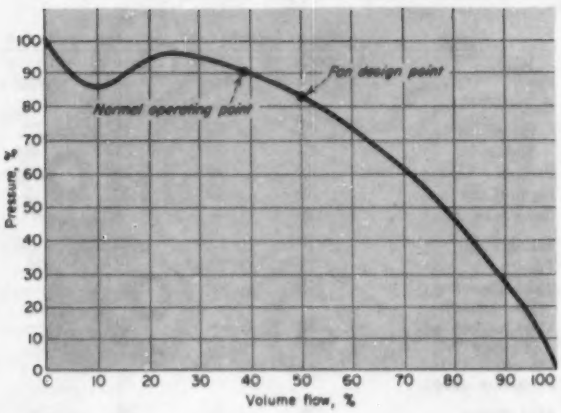
**The job.** Forced-draft fans supply energy needed to deliver combustion air to the furnace. Induced-draft fans remove combustion gases from boiler, discharge them to the atmosphere. In addition, i-d fans usually maintain a pressure (commonly called draft) in the furnace slightly below atmospheric, eliminating flue-gas leakage to the boiler room. Where the entire air and flue-gas systems are under positive pressure, i-d fans are not needed, but are often retained on a standby basis to permit emergency suction firing.

Air-side system components that we'll consider include: f-d fans, flow-control equipment, air-duct system and windbox. Combustion-gas system components, external to the boiler, include: economizer, air heater, flue-gas duct system, dust collectors, flow-control equipment, i-d fans and stack.

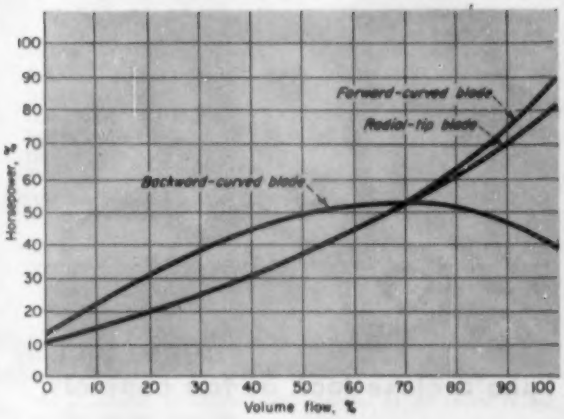
**Design conditions.** In figuring fan-design conditions we start with pressure and flow needed for rated-load boiler operation. Allowances added to these figures depend on: (1) type of fuel burned (2) possibility of slagging and fouling flue-gas passages (3) service conditions of boiler (4) type of air heater, economizer (5) chance of i-d-fan erosion when firing solid fuels.

Tables I and II, pp 90-91, list margins between fan-design conditions and actual fan requirements, for industrial and utility boilers using various fuels.

In setting up fan-operating conditions we assume that total air required for combustion is delivered by the f-d fan or fans, *and that all air passes through the air heater.* This last point takes on special importance when selecting fans




**FORWARD-CURVED-BLADE** fan is operated well to right of curve's jog. This is important when fans operate in parallel




**HORSEPOWER CURVES** of various fan types. Backward-curved blade can't overload motor. Reaches maximum, then drops off

for pulverized-fuel-fired boilers. Some boiler manufacturers supply performance data assuming that only 90% of the combustion air is delivered by the f-d fan, and passes through the air heater at rated load. Remaining 10% is tempering air.

In figuring that total air will be supplied by the f-d fan, we actually allow for burning coal that is high in surface moisture—the condition that calls for the maximum quantity of hot air delivered to the pulverizer.

**Infiltration** depends on a range of factors that vary with boiler and draft-system design as well as life of the installation and operator care. So, when estimating flue-gas volume flow, base infiltration allowances on poorest expected conditions. Table III, p 91, lists recommended allowances.

If a regenerative air heater is part of steam generating equipment, make allowance for leakage from air side to flue-gas side of the heater. Leakage can be expected through the seal mechanism. Most boiler proposals list estimated air-heater leakage. Where such data aren't available, a safe figure is: 10% of the air that enters the heater, in lb per hr, will leak through to the gas side.

**Corrosion** on the gas side of air heaters can be a tough problem. And steps taken to eliminate it often affect draft-system design. During cold-weather operation, hot-air recirculation increases air-heater tube- or plate-metal temperature, minimizing corrosion. If your air heater has this feature, you'll get a boost in air-weight flow and temperature at f-d fans—upping fan volume and, often, pressure.

With hot-air recirculation, be sure to keep hot air from impinging on f-d fan bearings. Also, if you're using regenerative type air heaters, you'll have to cope with a flyash problem at the f-d fan.

When cold air bypasses air heater to reduce corrosion on the gas side, you'll get a higher flue-gas temperature leaving the air heater—boosting i-d fan volume flow. Also, depending on system layout, bypassing the air heater may increase i-d-fan draft requirements.

Other methods commonly used to cut back air-heater corrosion are: (1) placing steam heating coils in air duct between fan discharge and air-heater inlet (2) using split-section tubular air heater—a cold section and a hot section.

Repairs on cold section of the air heater are made during scheduled boiler outages.

**Outward leakage.** Since the forced-draft system is under positive pressure, we allow for air leakage to the atmosphere. Possible leakage points are: damper-linkage openings, duct joints, air heaters, windboxes and expansion joints. Experience with a variety of installations shows that 3% of the total combustion air is a reasonable allowance.

**Brake horsepower** and fan loading are always based on maximum possible weight flow through fan. If inlet-air temperature design figure for the f-d fan is 100 F, assume volume flow for 100 F. Then calculate weight flow when inlet air temperature drops to 50 F—or other minimum expected air temperature. Caution: Locating f-d fans at upper levels of the boiler house, where warm air tends to collect, also boosts f-d-fan volume flow.

If you're recirculating hot air through the air heater to reduce corrosion, the recirculation condition will represent maximum weight flow through the fan.

Many of today's boilers are designed to fire more than one fuel. If your installation burns coal as well as oil, and delivers rated steam output with either fuel, figure maximum weight flow through i-d fans on the basis of coal firing. If i-d fan flow controls fail when you're firing oil, vanes and dampers may be manually set to their wide open position. Or, if you have variable-speed controls, they may be designed to run the fan at rated rpm when controls fail. In either case, base design conditions on maximum flue-gas weight flow. You may find that operating the boiler under control-failure conditions will actually govern fan design.

**How many fans** you'll have in the air and flue-gas systems is largely a matter of balancing technical requirements against economics of the situation. Points to consider are: (1) How reliable must boiler operation be? Is the unit serving a critical operation? Or, can outages be tolerated? (2) Do operating conditions—fuels burned, severe loading

**Take a close look at fan controls, horsepower needs, blade shapes, parallel operation, drivers**

**I: To get fan-volume design conditions, increase fan-volume flow at rated boiler load by these percentages**

| Fuel | Forced-draft fan | | Induced-draft fan | |
|---|---|---|---|---|
| | *Industrial plant* | *Utility plant* | *Industrial plant* | *Utility plant* |
| Coal | | | | |
| Pulverized | 25 | 20 | 25 | 20 |
| Stoker | 25 | 20 | 25 | 20 |
| Fuel oil | 25 | 20 | 25 | 20 |
| Natural gas | 20 | 15 | 20 | 15 |
| Coke-oven gas | 20 | — | — | — |
| Refinery gas | 20 | — | — | — |
| Tar | 25 | 20 | 25 | 20 |
| Blast-furnace gas (uncleaned) | 30 | — | 30 | — |
| Blast-furnace gas (cleaned by precipitator) | 20 | — | 20 | — |
| Petroleum coke | 30 | — | 30 | — |
| Acid sludge | 20 | — | 20 | — |
| Hogged fuel (wood) | 20 | — | 20 | — |
| Bagasse | 20 | — | 20 | — |
| Lignite stoker | 25 | 20 | 25 | 20 |
| Coke breeze | 25 | — | 25 | — |

conditions—call for frequent and unusual maintenance? (3) What is the estimated load? Is it continuous or intermittent? How large are peak loads?

While two f-d and two i-d fans per boiler yield the greatest flexibility and reliability, most small and medium-size installations can't justify this number economically. And often, in the small plant, space becomes the controlling factor.

But if you've decided on two fans per system, select them so that, with any one fan out of service, the boiler can deliver about two-thirds of its full-load steam capacity.

**Fan controls.** With a variety of control methods available, you'll want to take a close look at over-all economy as well as operating characteristics. Common control methods are: dampers or vanes, liquid rheostat and wound-rotor motor, magnetic coupling, hydraulic coupling, variable-speed turbine drive. In making a dollars comparison consider installed cost as well as operating costs. Power saving of one control system over another is based on estimated boiler loading for a year or other standard time period. Knowing required pay-out time for any incremental investment boost, you can decide whether such an investment is justified.

Power savings you'll get from a control system depend on difference between fan-design conditions and actual operating conditions. First graph, page 88, shows variation in horsepower for different i-d-fan control systems. This boiler is rated at 650,000 lb per hr.

Maintenance costs—a tough item to pin down closely—generally run about the same for magnetic and hydraulic couplings; lower on damper, vane, liquid rheostat and turbine speed-governing systems.

Damper and vane flow-control systems are about equal in installed cost. They're generally cheapest, with variable-speed types anywhere from 20 to 70% higher. Table IV compares approximate price range of variable- and constant-speed controls for four different boiler sizes in use today.

On the operating end, main items to check are: control stability, how control failure affects boiler operation, maintenance, and space requirements of the various control types.

Damper and vane controls respond quickest to changes in boiler load, give fastest combustion-control actuation. Liquid rheostats, magnetic couplings, hydraulic couplings and turbine drives are slower-response controls. But their slower, more sensitive changes reduce hunting possibility in the combustion controls—improving system stability.

**Control failure.** If you've decided on two f-d and two i-d fans per boiler, control failures aren't a critical problem. With one fan out of service, boiler can still be operated at about two-thirds of rated load.

But if detailed studies lead you to choose single fans in each system, pay careful attention to what happens when controls fail. Failure of damper, vane, liquid rheostat, turbine drive and hydraulic-coupling controls can still permit boilers to continue operating. On failure, control units maintain a constant set point that runs fans at their rated speed. Dampers and vanes are manually set wide open. Wound-rotor motor—used with liquid rheostat—operates as a constant-speed induction motor while you repair control equipment. Newest type hydraulic coupling operates fan at rated speed when variable-speed controls fail. Turbine drives will run at rated speed, or on hand throttle, until you've repaired controls. Magnetic-coupling failure calls for its removal and replacement with a *dutchman* or stub shaft, to continue boiler operation.

If your installation is short on space, check with manufacturer for size of his control units. Space needed for fan, motor and variable-speed controls with a magnetic or hydraulic coupling is usually greater than for other flow-control types. Liquid-rheostat controls can be set up in an area

## II: To get fan-pressure or draft design conditions increase fan pressure or draft at rated boiler load by these percentages

| Fuel | Forced-draft fan | | Induced-draft fan | |
|---|---|---|---|---|
| | *Industrial plant* | *Utility plant* | *Industrial plant* | *Utility plant* |
| Coal | | | | |
| Pulverized | 56 | 44 | 56 | 44 |
| Stoker | 56 | 44 | 56 | 44 |
| Fuel oil | 56 | 44 | 56 | 44 |
| Natural gas | 44 | 32 | 44 | 32 |
| Coke-oven gas | 44 | — | 44 | — |
| Refinery gas | 44 | — | 44 | — |
| Tar | 56 | 44 | 56 | 44 |
| Blast-furnace gas (uncleaned) | 68 | — | 68 | — |
| Blast-furnace gas (cleaned by precipitator) | 44 | — | 44 | — |
| Petroleum coke | 68 | — | 68 | — |
| Acid sludge | 68 | — | 68 | — |
| Hogged fuel (wood) | 44 | — | 44 | — |
| Bagasse | 44 | — | 44 | — |
| Lignite stoker | 56 | 44 | 56 | 44 |
| Coke breeze | 56 | — | 56 | — |

## III: Infiltration allowance for i-d fan volume flow at rated boiler load

| Firing | Infiltration, % of combustion air plus fuel, ash free |
|---|---|
| Pulverized coal or blast-furnace gas* | 8 |
| Stoker coal, coke breeze, lignite, hogged fuel | 14 |
| Oil | 6 |
| Gas | 6 |

*Use this figure when dust collector is used with b-f gas firing. If b-f gas is cleaned with precipitator before firing, use 6%.

| Distribution of infiltration allowance | |
|---|---|
| *Leakage into:* | *% of total allowance* |
| Boiler and furnace | 50 |
| Tubular air heater* | 20 |
| Duct system and dust collector | 30 |

*For regenerative air heaters, make allowance for air leaking to gas side through seal mechanism.

## IV: Approximate % increase in installed costs of fans, drivers and controls for variable speed, compared to fans, constant-speed drivers and controls using inlet vanes or dampers

| Boiler rating | Variable-speed control methods | | | |
|---|---|---|---|---|
| *lb per hr* | *Hydraulic coupling* | *Liquid rheostat* | *Magnetic coupling* | *Turbine drive* |
| 300,000 | 70 | 50 | 50 | 70 |
| 600,000 | 60 | 40 | 40 | 60 |
| 900,000 | 50 | 30 | 30 | 50 |
| 1,500,000 | 40 | 20 | 20 | 40 |

remote from fans and motors, eliminating a space problem.

**Drive selection.** Before deciding in favor of a turbine or motor drive take a good look at your plant heat balance. Is usable steam being thrown away? Is electricity being generated as a byproduct of process steam? Actual effect on plant heat rate, due to adding a turbine or motor drive, is often negligible—*if* exhaust steam from the turbine is used for feedwater heating, plant heating or process. But you'll do well to consider each case on its merits before making a decision on whether to install motor or turbine drives.

**Parallel operation.** Careful study of your fan's characteristics will insure good parallel operation. Forward-curved-blade fans should be operated inside of a limited range to get best results. Left-hand graph, p 89, shows the relation between normal operating conditions and fan-design conditions for forward-curved blade fans. Note that operating as well as design points are well to the right of jog in the curve, so that volume decreases as pressure increases.

If your choice is radial-tip blade fans, avoid those having characteristic curves with too much droop at shutoff.

**Fan erosion.** Dust particles in flue gas can play havoc with your i-d fan if right precautions aren't taken. Dust collectors—mechanical, electrostatic or a combination of both—are one of the best ways to minimize i-d-fan erosion.

Main items to look at in a study of possible i-d-fan erosion are: (1) quantity of dust in the flue gas (2) dust particle size and type (3) gas-flow pattern at i-d fan inlet (4) average blade velocity (5) for forward- or backward-curved blades—blade exit angle (6) absolute velocity of gas leaving the blade (7) gas velocity as it passes through fan blades.

Fan erosion patterns are difficult to predict. But critical erosion areas are the scroll, blades, center plate on a double-width fan and housing sides at outer edges. Engineers generally specify renewable wear plates for the blades, entire scroll and upper sides of the housing, to prolong fan life. Another good scheme is application of weld metal to center-plate sections of double inlet fans. If you're planning to use wear plates on sides of the fan housing, you'll need plates of 10-inch width on each side, around outer edges.

Right-hand graph, p 89, shows the shape of brake-horsepower curves for the three types of fans commonly used in power plants. Backward-curved-blade fans are nonoverloading. Note that its brake-horsepower curve reaches a maximum and then drops off. Forward-curved and radial-tip blades continue to pull more horsepower as volume flow goes up, allowing them to overload the driver.

**Blade-design differences** affect resultant air or gas velocity. Thus, fan speeds themselves can vary substantially, depending on the fan type you select. Whether your choice is forward-curved, backward-curved or radial-tip blades, be sure to consider blade-tip velocities. Tip velocities also affect air, gas velocities leaving the fan.

Rpm choice for fans, naturally, ties in with the type of driver you've selected. So blade design also depends on your motor or turbine.

To arrive at final system design give all these factors careful study—both on an economic and technical basis. Then you can be sure you've made the right decisions.

HOW TO ORGANIZE YOUR NEW POWER PLANT—14

# For best boiler operation, watch heat absorption and water level

**Here's how heat absorption affects boiler efficiency. The author also gives practical tips on controlling the water level and what to do if level becomes too high or too low**

By D C SWIFT, *Ebasco Services Incorporated*

► THE BOILER PLANT supplies steam required for turbines or steam engines, steam-driven auxiliaries and process use. Usually there is little or no steam storage, so production must correspond closely to use.

Two important factors in keeping steam flow at the required level are over-all heat absorption and the boiler water level.

**Heat absorption.** Temperature of the combustion products in a furnace is usually 2500 to 3000 F. Heat produced must be absorbed by the boiler water to make useful steam. Heat can be transmitted by radiation, convection and conduction. All three principles act in a steam-generating unit, depending on the boiler design and fuel.

Amount of heat radiated per unit of area varies approximately as the fourth power of the temperature difference between the hot and cold bodies. The exposed area of both bodies determines the quantity of heat transferred.

A natural-gas flame, being relatively clear and transparent, has a limited radiation capacity compared with the luminous flame from oil or coal. This means that less radiant heat is usually absorbed in a gas-fired unit.

Heat not radiated from the combustion gas in the furnace passes on in the hot flue gas. Usually gas flows over the superheater, boiler, economizer and air-preheater before going to waste.

Hot gas flowing over these relatively cool parts causes heat to transfer in proportion to the temperature difference between gas and metal. Rapid flow scrubs the layer of static gas off the surface of boiler parts and increases heat-transfer rate for a given temperature difference.

Metal boiler parts are heated by radiation or convection. Heat passes from the hot outer to the cooler inner surfaces of the metal by conduction. Metal type, thickness and area determine the amount of heat transferred. This, in turn, is in proportion to the temperature difference through the metal.

Next, convection and conduction transfer the heat to the water, steam or air in boiler, superheater or preheater. Temperature difference and flow velocity determine the amount of heat transferred per unit of surface. Over-all heat transfer per unit of area depends on the conductivity and thicknesses of the gas layer, the metal, and the steam-, water- or air-layers.

A slag or soot coating on furnace side of a heat-absorbing element reduces the amount of heat transferred by radiation or convection from hot gas to the boiler metal. Scale or sludge on the tube's inner surface also materially cuts heat transfer.

If metal temperature rises toward furnace temperature, the overheating may weaken the metal so much that it fails. Avoid scale on inner boiler or superheater sufaces. It is dangerous and wasteful. A coating on outer surfaces may cause troublesome slag deposits in gas passages, or overheating of furnace refractories, as well as heat waste.

Rapid gas movement helps scrub off the inert gas film close to the metal surfaces. Similarly, rapid water circulation scrubs off insulating water film and steam bubbles forming on inner boiler surfaces. Fast steam flow through all superheater elements keeps them cool and avoids overheating metal.

For efficiency, keep heat transfer throughout the boiler high. Also, fuel must be burned to the best advantage. To control superheat, use various adjustments to change mass flow or temperature of gas passing the superheater. Otherwise, you can adjust fire position or clean slag from furnace walls to change proportion of radiant and convection heat absorbed in superheater.

**Water supply.** Water must be continually supplied to the boiler to replace the steam that is being produced. Modern boilers have a relatively small reserve supply in the drums, often equivalent to only a minute or two of full-load operation, before the level drops so low that circulation in waterwalls or boiler tubes is affected.

Water supply must be unfailing, and closely match the steaming rate. The supply pressure has to be great enough to force water into boiler against steam

pressure plus friction in valves, piping and economizer. Have water level within a very few inches of normal, because high water may carry over and damage superheater or turbine, while low water may damage boiler.

**Water level.** Water columns equipped with gage glasses are standard means for observing drum-water level. Each boiler usually requires two columns. To be sure lines are clear and gage glass is showing the right level, blow down columns and connecting lines frequently. Usual practice is to blow down the columns at the start of each shift.

Be sure the normal level desired in the steam drum is properly associated with the gage glass. Often the center of the glass is not the proper level for operation; but it is desirable to have this relation if practicable.

Blow down the water glasses gently, if at all. Round high-pressure glasses, or flat ones, using mica to protect the glass from water erosion, are quickly roughened by blowing a high-velocity stream of water through them. Blowing down the column usually washes the glass sufficiently at the same time.

The steam line from drum to water column and the column itself are usually left bare. This increases steam-condensation rate and keeps both water line and glass full of hot condensate approaching the temperature of the drum water. If there is a large difference between column and boiler temperature, you may have considerable error in level indication. Don't use stop valves in lines to water columns unless they are padlocked open.

Be sure water-column lights have a dual power supply to insure against power failure. Bicolor glasses require careful adjustment and alignment to assure that the correct level is shown.

If your installation uses mirrors to transmit water-column image to operator's control point, see that mirrors are carefully aligned and permanently set in position. Use closed ducts to keep out dirt and extraneous light for transmission of a good bright image for any distance. Provide inspection doors for easy cleaning of mirrors.

A spare gage glass can be readied at leisure and quickly installed in case of glass failure. Some plants use television installations to supplement mirror arrangements for viewing water columns remotely.

Remote-operated water-level recorders or indicators may supplement directly viewed water columns. But they should not replace the water columns. Be sure connections to these instruments are taken at separate correct locations on the drum, and static reservoirs are located so level shown by instruments is same as that in water columns.

Leaks, line stoppage, freezing or even major temperature differences cause erroneous readings, and the instruments themselves are also subject to trouble. It is a good plan for two units to use separate connections and lines if you plan to depend heavily on water-level recorders or indicators. When first firing a boiler, correct level may not be indicated for some time until lines and level pots have filled with condensed steam and cooled. This is particularly likely if the lines have been blown down, drained or equalized during shutdown.

High- and low-level alarms are often used in connection with level recorders. On lower-pressure boilers, floats in the water column may operate a warning whistle. Such devices are helpful, but don't rely on them implicitly. Operator should continually check water column visually to be sure water level is right.

**Feedwater regulators.** Most boilers have some form of feedwater-regulating valve designed to maintain boiler-water level by regulating flow (see April, p 118). Either the shutoff valves and bypass for the regulator should be convenient to the operating control center, or you should have remote controls at that point. It's convenient to have a smaller bypass and valve in parallel with the full-capacity bypass for use during filling and firing-up periods. One of the water columns or mirror systems should be visible from this manual-control point to facilitate control of the water level.

Feedwater regulators all operate basically to maintain a set water level in the boiler steam drum. Maintaining a steady level may require excessive variations in water-flow rate, while a steady flow requires widely varying levels. The object is to reach the best possible compromise.

The simplest feedwater regulators operate on direct impulse from a float in a chamber connected to boiler drum and set at normal water level. These units may incorporate an extra valve to help hold a steady, low-pressure differential across the feedwater-regulating valve. This control may be sluggish at high loads. Water level falls if differential is too small.

Other regulators operate on the principle of (1) expanding a thermal tube or (2) increasing pressure from a generating tube. The generating tube is exposed to varying amounts of heat, depending on relative level of water and steam in the element. These regulators are simple and rugged. They must be protected from excessive ambient temperature change, yet have enough air flow to cool the portion of the actuating element filled with water.

Larger-size regulating valves, especially for high-pressure boilers, are usually pilot-valve-operated to attain better power and permit remote control. Operating medium is usually air or oil under pressure. These control valves are generally arranged for remote manual control with a position-locking arrangement that operates if you lose pressure on the operating medium. Operators should practice transferring from automatic to manual control.

For best operation of any regulating valve, be sure there is no friction due to excessively tight packing, bent stems or linkage. Eliminate excessive play or looseness in the linkage.

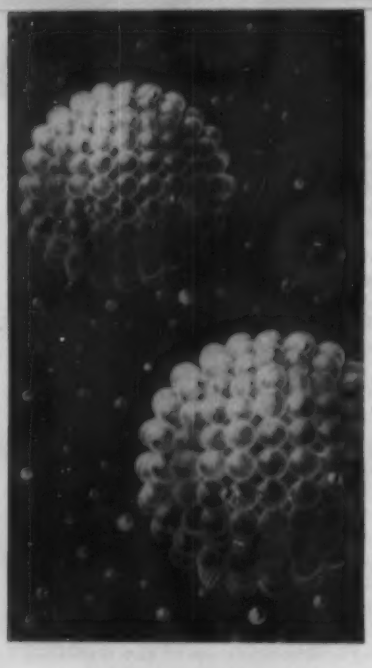
Sometimes, instead of installing a regulating valve at the boiler, the boiler feed-pump's speed may be controlled to produce just enough pressure and flow to the boiler to maintain desired water level. This saves feed-pump power, but control may be slightly slower depending on the particular steam, electric or oil system of variable-speed control used. Try out the adjustments to get the proper degree of response compatible with reasonably steady maintenance of water level.

Keep a spare pump ready to cut into service promptly in case of trouble with the speed control. Weekly practice in changing from automatic to manual control and back again is advisable.

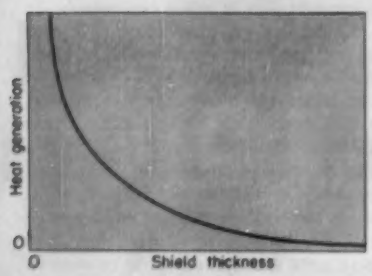
**Blowdown.** Most low-makeup boilers do not require frequent blowdown of water-level-regulator control lines. But on high-makeup boilers, tendency for lines to plug may require frequent blowdown. Regulators must be put on manual control during blowdown, and until lines have cooled and conditions have returned to normal. Water level should be at normal control point of the automatic regulator before cutting regulator into service again.

**Improper water level.** Feedwater-regulator trouble may cause water level to become dangerously high or low. If it is excessively high, so as to endanger turbines with carryover water, the quickest remedy may be to stop the feed pumps. But if they cannot be quickly restarted as boiler-water level drops,

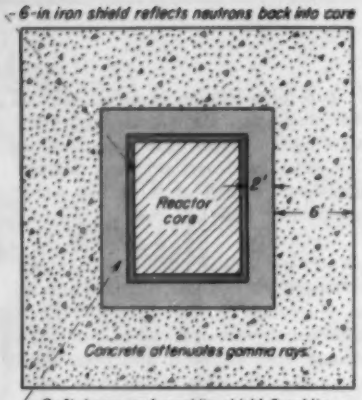
(*Continued on page 206*)



**NUCLEAR-ENERGY STUDY COURSE: NUMBER 10**




**1** As shield thickness increases, the heat generated by radiations reduces


6-in iron shield reflects neutrons back into core
Reactor core
2'
6'
1'
Concrete attenuates gamma rays
2-ft boron and graphite shield. Graphite slows down neutrons, boron nuclei absorb neutrons and emit alpha particles.

**2** Shielding surrounding reactor core makes up the unit's bulk of volume

**Using a reactor for power generation means giving careful attention to many details. We have already talked about available energy, neutron flux distribution, coolant flow, reflectors and control methods. Now let's talk about . . .**

# Radiation shielding and power cycles

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► IN OUR CONVENTIONAL power plants, heat insulation is one of the main forms of protection provided for operating personnel. In nuclear power plants, we need much more than that for operator safety. Fission reactions emit neutrons and gamma rays. These two radiations (the most deadly) are the most difficult to absorb or attenuate (reduce) to the point where they will not injure operators. Other emitted particles, like alpha and beta particles, are not as harmful and can be easily stopped.

Materials for shielding against neutrons and gamma rays vary:

*Neutron shielding:* Boron, light water, oil, graphite.

*Gamma-ray shielding:* Lead, concrete, concrete with added magnetite or barium, steel, tungsten can be selected.

An effective shield must have: (1) a material that will slow down (thermalize) neutrons—increasing the probability of capture by an absorption process (2) a poison or absorbing material that will capture thermalized neutrons. "Borated graphite" (graphite plus boron) meets these two conditions. The graphite slows down the neutrons and the boron nucleus absorbs the neutron in a (n, $\alpha$) reaction:

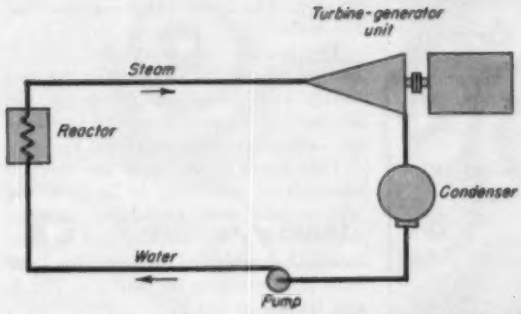
$$_5B^{10} + {}_0n^1 \rightarrow {}_3Li^7 + {}_2\alpha^4$$

The reaction produces lithium plus an alpha particle. The alpha particle is easily stopped.

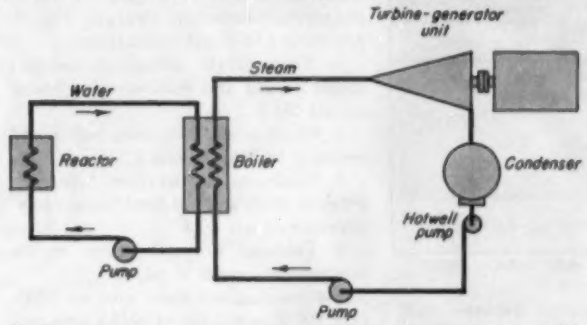
For gamma-ray attenuation the dense (heavy) materials are best. The nucleus absorbs the gamma-ray energy and may emit an electron and positron. When these two particles combine they emit a secondary gamma-ray energy that is negligible compared to gamma rays produced by fission.

**Shielding factors.** Radiations absorbed by shielding mean an absorption of energy. This heats up the shield and it may have to be cooled to prevent its destruction. For example, concrete must be kept below 150 F and its thickness less than a certain amount to prevent too large a temperature difference that may cause destructive thermal stresses. Fig. 1 shows how heat production in shielding varies with its thickness, dropping with increasing material.

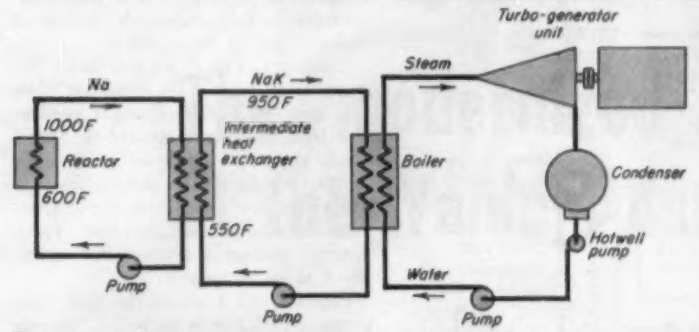
In choosing shielding materials we must consider:




**3** Simplest arrangement uses reactor coolant as the fluid to drive turbine. Example might be boiling-water reactor




**4** Evaporating steam in a separate boiler avoids the possibility of making the turbine and its auxiliaries harmfully radioactive




**5** Proposed 2-coolant system uses Na in the reactor and transfers heat to intermediate NaK circuit that acts as buffer against radioactivity

1. Shielding effectiveness (radiation attenuation)
2. Material availability
3. Material cost
4. Cooling requirements
5. Stability of physical properties under radiation attack.

Fig. 2 shows a typical shielding arrangement for a nuclear reactor. Placing a reactor below grade (burying) uses the earth as radiation shielding. This would be in addition to using other materials mentioned before.

A 2-coolant system, Fig. 5, uses an intermediate coolant circuit to reduce radioactivity problems in rest of plant. This circuit acts as a buffer between radioactivity in the primary coolant circuit and the steam water circuit.

**Nuclear heat to electric power.** Theoretically there are four ways to produce electric power from nuclear fissioning of uranium:

1. Direct generation of electric current from electrons released during nuclear fissioning.

2. Direct generation of electric current from heat energy produced by nuclear fissioning—for example, by thermocouples.

3. Direct use of gas, vapor or liquid that cools the reactor to drive a turbine or other heat engine.

4. Heating of water by reactor coolant to produce steam for driving a turbine or other heat engine.

The last two methods are the only apparently practical ones at this time. Fig. 3 shows the circuit for method 3, while Fig. 4 and 5 show circuits for method 4.

Power production being a practical business venture, the selection of a nuclear plant depends on economic evaluations of different possible schemes. Such studies will determine: (1) reactor type (2) reactor coolant (3) power-producing cycle.

**Cycle choice.** Let's look at some of the arrangements and factors involved in choosing a nuclear-generating plant:

*A. Boiling water reactor*:

1. Possible radioactivity of steam-power equipment and piping may require some radiation shielding. Accessibility for maintenance and repair may be seriously hampered. Future experimental work must give the answers.

2. Radioactive particles in steam may require special shaft seals on turbines, pumps, valves, etc. Some engineers think this is no problem. Others fear ingestion of radioactive vapors or gases may peril operators.

3. Noncondensible gases removed from condenser may be radioactive.

*B. Gas-cooled reactor*:

1. Large quantities of gas must be circulated in practically-sized power plant to handle energy needed.

2. Gas pressure to reactor, cycle pressure differential, size of gas compressor and power needs all pose problems.

3. Gas used as coolant determines size of turbine. For example, using helium as coolant will need a gas turbine with two to three times the number of stages in a steam turbine for equivalent conditions.

*C. Using reactor coolant to generate steam*:

1. Availability of coolant and its cost.

2. Compatability of reactor coolant with water or steam.

3. Suitability of coolant within temperature range in reactor and heat exchangers.

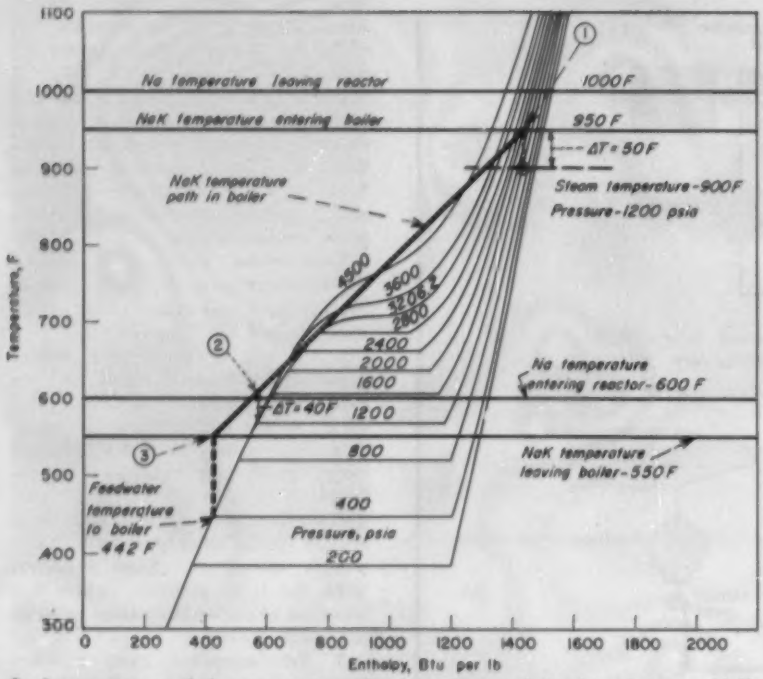
4. Vapor pressure-temperature relationship of coolant and working fluids.

5. Toxicity of fluids.

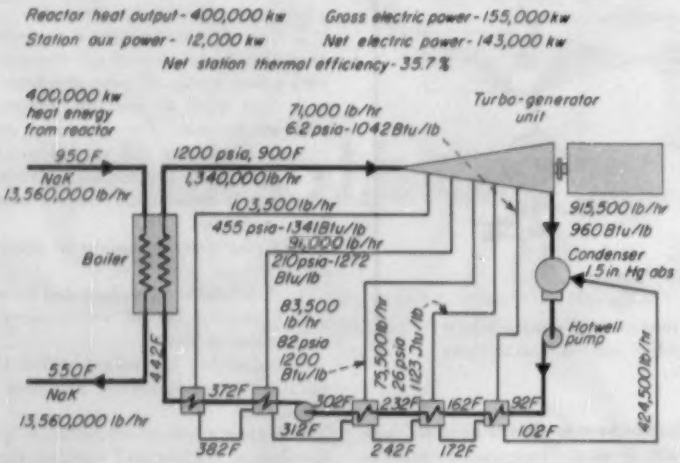
6. Other factors, such as corrosiveness, pumping power, heat-transfer properties, etc.

Water appears to be the most likely working fluid for nuclear plants under all the categories of *A*, *B* and *C*. This seems to hold despite the disadvantages of (1) high pressures for relatively moderate temperatures (2) the ability to dissolve almost any material over a period (3) potentially violent reaction with alkali metals used as reactor coolants.

**Cycle analysis.** Now let's see what factors we must consider in making a preliminary choice of plant cycle. Ac-




**6** Steam-water enthalpy-temperature diagram shows relationships between NaK circuit and the steam circuit. Keeping steam conditions high raises efficiency




**7** Using 5-stage regenerative cycle with 1200-psia 900-F steam contributes to realizing high over-all thermal efficiency. Capital costs must be studied also

cording to Carnot's principle the cycle efficiency depends primarily on the absolute temperature of the energy source of the cycle $T_1$ and the absolute temperature of the region to which unavailable energy is rejected, $T_2$. Knowing these two factors the maximum possible thermal efficiency equals $(T_1-T_2)/T_1$. In the practical case, $T_1$ is the temperature of the reactor core and $T_2$ the temperature of the cooling water used to condense steam at the turbine exhaust. Since we can't do anything to lower $T_2$ we can raise efficiency only by making $T_1$ as high as reactor materials will allow. Any other design features merely reduce the practical losses that make the theoretical efficiency unattainable.

To point up the principles and relationships involved let us consider a numerical example. Fig. 5 shows a 2-coolant system using a reactor with sodium as primary coolant and a secondary coolant of sodium-potassium (NaK). The latter generates steam in the boiler.

The sodium temperature of 1000 F leaving the reactor depends on the materials and design conditions of the reactor. These also help fix the entering sodium temperature of 600 F.

This example assumes an average temperature difference of 50 F in the intermediate heat exchanger between the Na and NaK coolants, and no heat losses in connecting piping. We then have NaK entering the boiler at 950 F and leaving at 550 F.

We next must find our steam and water conditions. For this we use a temperature-enthalpy diagram, Fig. 6, and some additional assumptions:

1. Temperature difference between steam leaving and NaK entering boiler equals 50 F.

2. Steam pressure leaving boiler and entering turbine equals 1200 psia.

3. Minimum temperature difference between NaK and saturated-steam temperature equals 40 F.

4. Pressure drops between circuit components equals 0 psi.

These assumptions then give us 1200-psia 900-F steam out of boiler into turbine with a corresponding saturation temperature of 567 F. The NaK temperature leaving evaporator section of boiler = 567 + 40 = 607 F.

Turning to Fig. 6, we first locate the steam state leaving the boiler at 1200 psia and 900 F. Projecting a vertical line from this point upward to 950 F (NaK entering boiler) we locate point *1*. Next we locate the point where the water enthalpy line intersects the 1200-psia evaporation enthalpy line. From here we project a vertical line up to 607 F to locate point *2*.

Points *1* and *2* are on the NaK temperature path line in the boiler. Assuming that the NaK has a constant specific heat while flowing through the boiler we can draw a straight line through *1* and *2* and extend it to intersect the 550-F temperature line at point *3*. Dropping a vertical line from *3* to the water enthalpy line we find a feedwater temperature of 442 F. This method assumes zero heat losses from the system. This analysis should be used only when the reactor coolant does not do work in the turbine.

**Steam cycle.** Having fixed the temperature-pressure conditions let us see what we would have with a reactor capacity of 400,000 kw of heat energy. Fig. 7 shows the steam heat balance with five stages of regenerative heating, each with equal temperature rises. Turbine performance was based on *Comparative Efficiencies of Central Station Reheat and Non-Reheat Steam Tur-*

(*Continued on page* 198)

Power MODERNIZATION PROGRAM

**A 1954 award winner**

**CONTROLS** permit engineers to select ballroom temperature from central office

**By turning the old system upside down . . .**

# They modernized air conditioning at the Waldorf-Astoria

► "MODERNIZE the Grand Ballroom's air-conditioning system—but don't interfere with the parade of banquets and shows that use the ballroom continuously. And get the job done without interrupting air-conditioning service."

These were the ground rules that consulting firm Seeyle, Stevenson, Value and Knecht faced, when they teamed up with Waldorf-Astoria engineers to plan an up-to-date air-conditioning system for the ballroom. To do the job they—for all practical purposes—turned the old system upside down. Here's how they did it.

**Old air-handling system,** drawing, page 99, could supply 35,000 cfm to ballroom through perimeter supply ducts. A second perimeter supply duct fed ballroom boxes. Decorated ceiling featured a central smoke-exhaust plenum chamber. Just above ballroom ceiling, the 7th-floor machine room housed five air-washing units to condition ballroom air.

After considering and rejecting a variety of methods for boosting air supply—because they would interfere with ballroom gatherings — engineers hit upon a clever arrangement: Old smoke exhaust would become the supply chamber. Existing perimeter supply could then serve as exhaust.

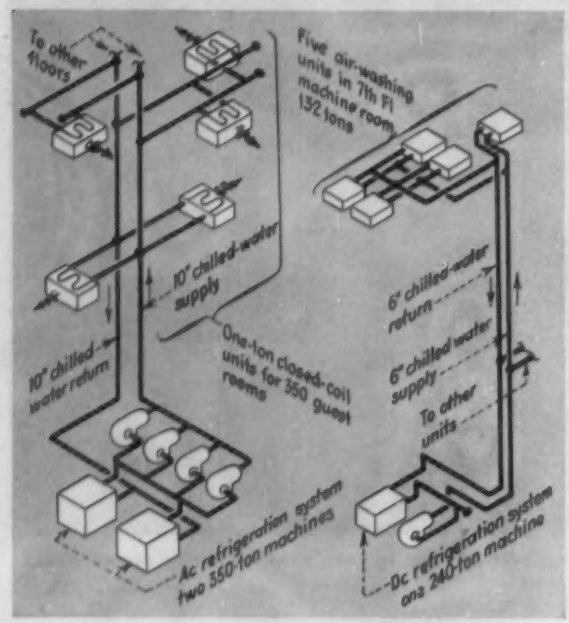
But how could the entire ballroom receive air from a central chamber and still get complete air coverage? A 5-ft-diameter circular diffuser proved to be the answer. In addition, 22 vaned deflection grilles, normally used only in walls, surround the diffuser. Air from ceiling diffuser enters ballroom in horizontal-radial directions, pushes aside enough air from deflection grilles to cover the ballroom floor.

**Diffuser installation** presented another tricky problem. Center of the existing false ceiling, suspended to form the plenum chamber, consisted of open molded-plaster grille work. So trying to cut an opening for the ceiling diffuser could collapse the ceiling—if it wasn't solidly reinforced. To do the job, SSV&K designed a reinforced-plaster ring and metal cone that could be installed without erecting scaffolding. When opening was cut (from above ceiling), scrap material fell harmlessly into the sheet-metal cone.

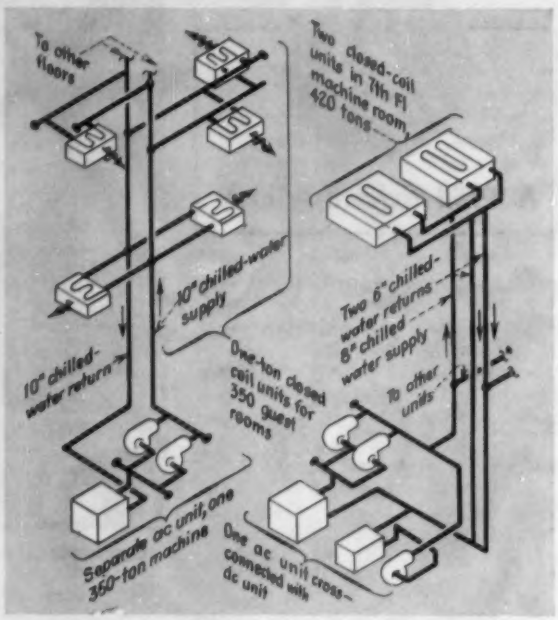
Two year-round air conditioners, 40,000 cfm each, replace five air washers in the 7th-floor machine room. Each unit has automatic oil filters on opposite sides of a common outside and return-air plenum. Steam-preheat coils, chilled-water coils and steam-reheat coils follow filters. System was designed to keep air velocity, across coils, low—keeping condensed moisture from blowing

*Power* acknowledges cooperation of E B J Roos, partner of Seelye, Stevenson, Value & Knecht, and T Barrett, bldg supt, Waldorf-Astoria, in furnishing information for this article.

## Chilled water, refrigeration

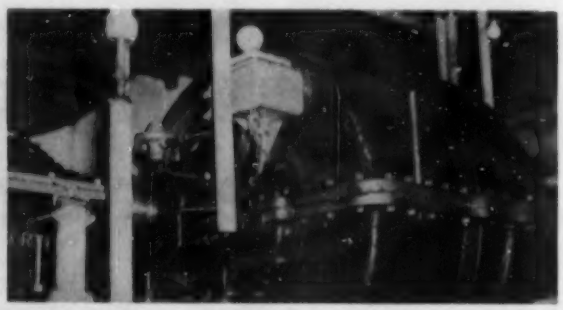

To other floors
Five air-washing units in 7th Fl machine room, 132 tons
10" chilled-water supply
6" chilled-water return
6" chilled water supply
10" chilled-water return
One-ton closed-coil units for 350 guest rooms
To other units
Ac refrigeration system two 350-ton machines
Dc refrigeration system one 240-ton machine

**BEFORE:** Separate dc and ac chilled-water systems air-conditioned the grand ballroom and the bedrooms


To other floors
Two closed-coil units in 7th Fl machine room, 420 tons
10" chilled-water supply
Two 6" chilled-water returns
8" chilled water supply
10" chilled-water return
One-ton closed coil units for 350 guest rooms
To other units
Separate ac unit, one 350-ton machine
One ac unit cross-connected with dc unit

**AFTER:** Cutting loose one ac compressor from bedroom circuit and replacing old air washers ups capacity

**CHILLED-WATER PUMP** discharges to new 8-inch riser. Old supply and return lines were manifolded to form dual return



**DC COMPRESSOR,** installed in 1930, is a 240-ton unit. Now teams up with ac compressor to handle ballroom refrigeration

through. Reheat coils make it possible to hold humidity down to comfortable levels—even under crowded conditions on muggy days.

Since existing ductwork was oversized for its original 35,000 cfm, added air supply is still handled by these ducts.

**Chilled water** and refrigeration sides of modernized system, drawings above, made top use of existing equipment. In 1930, dc power was available from New York Central RR power plant under the Commodore Hotel. So a 240-ton dc motor-driven centrifugal compressor was installed at that time. Five years later, Waldorf-Astoria engineers added a separate centralized system to pick up a 350-guestroom load. Change in the electrical power situation, by 1935, dictated purchase of two 350-ton ac machines—one a standby.

With 970 tons available from three compressors, this latest modernization had little need for more refrigeration capacity. Existing chilled-water pumps were also adequate. Main problem was how to make best use of these units.

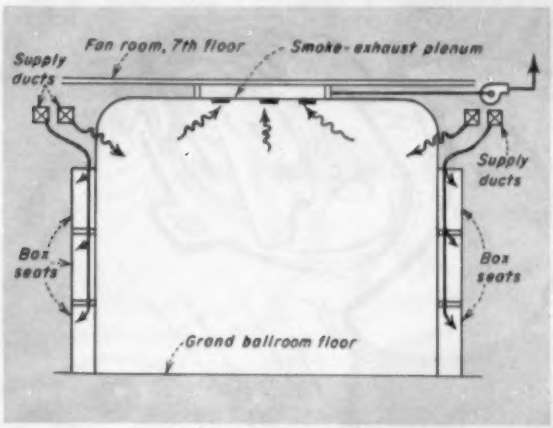
Drawings above show how one ac compressor was cut loose from guest-room system and tied in parallel with dc unit supplying the ballroom. Engineers couldn't tie all three compressors to one header (for maximum flexibility) since the dc system contains equipment that can't take higher pressures existing in the ac system.

Chilled water is now delivered to air conditioners via a new 8-inch riser. Old 6-inch supply and return lines were manifolded together, now serve as a dual return line.

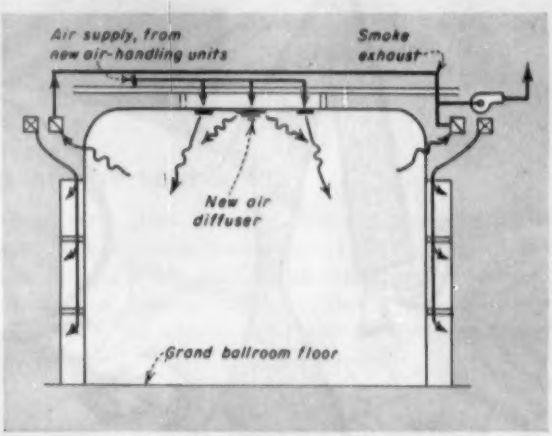
**Centralized control system,** for temperature and humidity, allows remote temperature selection for the ballroom as well as other public areas.

Recent General Motors show—the Motorama—really put system to the test. With a standing-room-only crowd watching the exhibit, conditioned air was clean and fresh at all times.

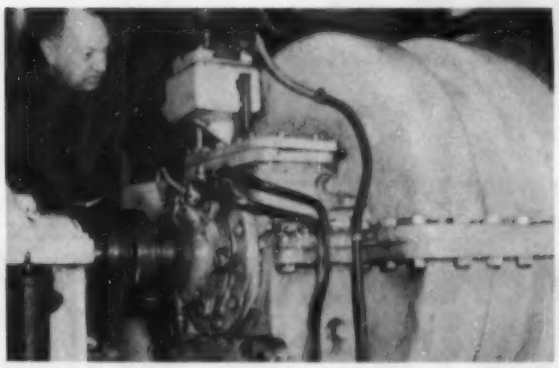
## Air side




**BEFORE:** Smoke-exhaust plenum chamber and perimeter air supply delivered 35,000 cfm to grand ballroom




**AFTER:** Circular diffuser, square deflection grilles and supply to ballroom boxes deliver 80,000 cfm



**AC COMPRESSOR,** one of two units installed in 1935. This 350-ton centrifugal machine was cut loose from bedroom system

**NEW AIR-CONDITIONING EQUIPMENT**

**Waldorf-Astoria Hotel**

Central air conditioners, 2 .....Typhoon Air Conditioning Co, Inc
40,000 cfm each, automatic oil filters, preheat coils, reheat coils, chilled-water coils
Air-handling fans, 2 .....Bayley Blower Co
40,000 cfm each
Air-conditioning controls .....Johnson Service Co
Mechanical contractors .....S J O'Brien Sales Corp
Consulting engineers .....Seelye, Stevenson, Value & Knecht


### Time's running out, but . . .

# You can still enter the 1955 award program

**THERE'S STILL TIME.** Entries for POWER modernization awards are being received to May 15th.

If you've completed a power-service modernization during the calendar year of 1953 or 1954, don't miss this opportunity to win recognition for your accomplishments.

**ANY PLANT CAN ENTER.** Small as well as big plants that have modernized all or any major part of their power services—boiler plant, generating equipment, electrical distribution, heating, air conditioning, refrigeration, compressed air or water systems—are eligible.

**WHO SUBMITS ENTRIES?** Staff members of any steam, diesel or hydro plant—in industry, institutions or utilities—may submit entries. Also, consultants may enter for their clients.

**HOW TO ENTER.** Our simplified entry blank makes it easy for you to give us the facts. All you need do is answer the streamlined questions on it. We'll do the rest.

**DON'T DELAY.** The only way to win an award is to submit an entry promptly. So drop us a line for an entry blank. We'll shoot it out to you with instructions.

***Relax!* It's easy to keep up with job info when you know . . .**

# How to get more value out of

To get the most out of your technical reading, keep its purpose always in mind. You read an industrial magazine for profit—not for pleasure, although that may be a welcome by-product. Basically you're looking for ideas, for know-how that will help you do your job better.

Some issues are bound to have more that's helpful to you than others. Remembering that it takes only a few good ideas to repay you for the time you spend and the modest cost of a subscription, the trick is to spot the payoff items quickly and efficiently. This calls for special reading habits that any reader can develop with a little practice.

Good technical magazines are edited to speed the idea-finding job. With specific reference to POWER, this article tells how to use the signposts the editors erect to make your reading more profitable.

## The big idea: Be selective

This whole business of latching on to job information is a process of selection. You can't cover all the bases yourself, so you begin the process by subscribing to one or more magazines—in effect, you choose some editors to play on your team. Acting for you, they carry the selecting work a step farther. They comb the field for problem-solving ideas likely to be of value to you and others with similar interests.

Some of the dope they dig up will be of prime concern to you, some to other readers in the group. So you step back into the selecting process. In each issue there will be some material you'll want to read carefully, some you'll want to skim, some you'll want to pass over. You must decide.

An editor can make your selecting job easier in many ways. Knowing how to recognize them makes your reading more efficient. And the extent to which an editor helps his readers find and choose what's for them is a pretty useful measure of how good a magazine he produces.

## Start by learning your way around

Most magazines group material in much the same pattern within each issue. Knowing this pattern helps you find things fast. POWER, for example, has a carefully organized 3-part structure. This shows clearly in the table of contents (always on p 3).

First of POWER's three sections is *Engineering and Management*. It deals with planning, plant design, equipment selection—all the things you want to know when setting up new power-service facilities or modernizing old ones. And it reports new developments and trends.

In *Plant Operation and Maintenance Section*, men responsible for

## Today, you need more job info than ever

It's always been smart to add the ideas and experience of others to your own stock of know-how. But now it's downright necessary. If you're to take wise action in job situations that get more complex all the time, you've got to keep tabs on all the new angles

## But you're too busy to tap all the sources

The facts you need come from many quarters—engineers in other plants, consultants, manufacturers, researchers. From this sea of information you can fish out a few items by personal contacts—conversation with well-informed salesmen, visits to friends' plants, an occasional technical meeting. But what about the new ideas you don't hear of, the plants you can't visit, the reports you never see?

## That's where the technical editor steps in

The staff of a topnotch industrial publication acts as your eyes and ears, taps all the information sources you'd like to reach, many you don't even know about. The magazine they produce is their report to you—a fast-moving summary of what's ahead in your field, a roundup of problem-solving ideas. For maximum profit, you should know the tricks of using this report efficiently—the article below gives them

---

# *technical magazines in less time*

keeping power-service setups running smoothly exchange experience, pass along practical know-how on equipment and methods.

*Reader Service Section* does two big jobs for you: (1) It rounds up technical and business briefs, the month's new products and literature. (2) It offers an easy way to get additional information on any item.

## Shop for ideas in handy packages

Another way editors help you find what you want is by packaging recurring types of material in regular locations within the main magazine framework. Some of these "departments" are common to all magazines —the table of contents, for example. Others are unique, like POWER's famous *Marmaduke Surfaceblow* stories. Many—like the *Data Sheet*—serve lasting needs and appear regularly for years. Others—like the *Nuclear Notes* page—are added to meet timely demands.

Knowing what you can expect to find in these regular information packages is another short cut to getting top value out of your reading.

## How to spot what's for you

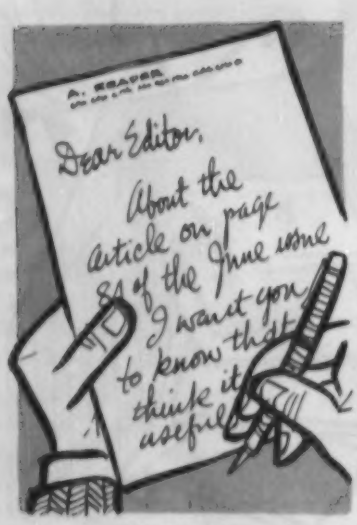
Articles in today's top magazines look a whale of a lot different than they did years ago—and there's a reason. Just as a good editor organizes the main elements of his publication to make information-seeking easy, so he builds each article with the same objective. How does he do it?

First, by putting headline material and pictures into meaningful relationships, he tries to give you the general nature of the article at a glance, to answer the question, "Is this for me?" Then by telling as much of

**Be selective**

Watch for special features

# Here's how to benefit most from your time spent with Power




Participate

the story as possible in photos and drawings, and by highlighting the text with skillfully placed subheadings he makes it easy to skim, if that's your wish. The same organization of material makes full and careful reading easier and faster.

Finally, he'll often give you a reading "option." He'll tell the main story for the reader who wants the quick facts. And he'll package the supporting technical details for the reader who wants the works.

Examine any issue of POWER for examples of these article-building methods, see how they make your idea-searching easier.

## More ideas per reading minute

You've heard a lot lately about new methods of boosting reading speed and comprehension. They do a good job in many cases. So if you have a chance to take part in such a program, give it a try.

We believe, however, that easy reading starts with good writing. So you'll find POWER stories told in short, pithy sentences. We sweat to express ideas clearly. And we shun technical mumbo jumbo.

## 'Specials' pay extra dividends

About five times a year, POWER readers get a dividend. Four of these are the now famous special reports which have been published regularly since 1935. These manuals give complete up-to-date information on some one subject—like pumps, packing, motors, refrigeration. They're available in reprint form—if you need an extra copy for your files, or want a quantity for training your staff, send for the current price list.

The fifth dividend is the extra Mid-September issue. For your year-round reference it carries the only directory of power-field suppliers, plus a roundup of new products and literature. Among the editorial features is the unique *Modern Plant Survey*, which summarizes plant design trends, tabulates technical data on new steam and hydro installations.

## Dig those ads for pay dirt

Advertising does two big jobs for you, the magazine reader. For one, the ad pages bring you a wealth of information on new products and processes. Without leaving your desk, you can shop them for problem-solving ideas, just as you shop the editorial pages.

The second value of advertising to you is wrapped up in the economics of publishing. Topnotch editorial service wins readership. Strong readership wins advertising. And healthy advertising provides the income needed to support a first-class editorial job. Pick up a magazine chock-full of ads. The odds are you'll find in its editorial pages visible evidence of a large staff geared to seek out the material you need and present it with the best modern illustration and writing techniques.

## Use the reader services

POWER's reader service department is equipped to give you fast help when you want more info on new products or need manufacturers' literature. Use the handy postcards supplied in each issue. Reader service is also headquarters for your reprint needs. Ask for the current price list.

Don't hesitate to call on POWER editors for help. They're glad to meet any reasonable request for information and assistance.

## It's your magazine—pitch in!

A technical magazine is built on the exchange of ideas and experience. It's easy to play your part, because POWER's staff is geared to work with you. Just let us know what you've been doing in your plant—if it will interest other readers, we'll do the rest.

Finally, remember that we edit POWER for you. We want to know what you think of it, how it can be improved. Each month we ask selected readers for this kind of help. But don't wait to be asked. Let us hear from you—whether it's flowers or brickbats, we want frank opinions.

# Power's DATA SHEET

No. 275

## Your heat loss through open windows

► HEAT LOSS through open windows can be expensive. Temperature difference, between indoors and outdoors, and height of window opening above ground combine to produce a stack effect. This can push a large warm-air flow out of an open window.

This chart gives a rough approximation on the size of the loss for given conditions. The chart is based on two equations:

$$Q = 9.4A\sqrt{h\Delta t}$$
$$H = 60dQc_p\Delta t$$

where

$Q$ = air flow, cfm
$A$ = open-window area, sq ft
$h$ = window-opening elevation above ground, ft
$\Delta t$ = inside minus outside temp, F
$d$ = air density = 0.073 lb per cu ft
$c_p$ = air specific heat = 0.24 Btu per lb

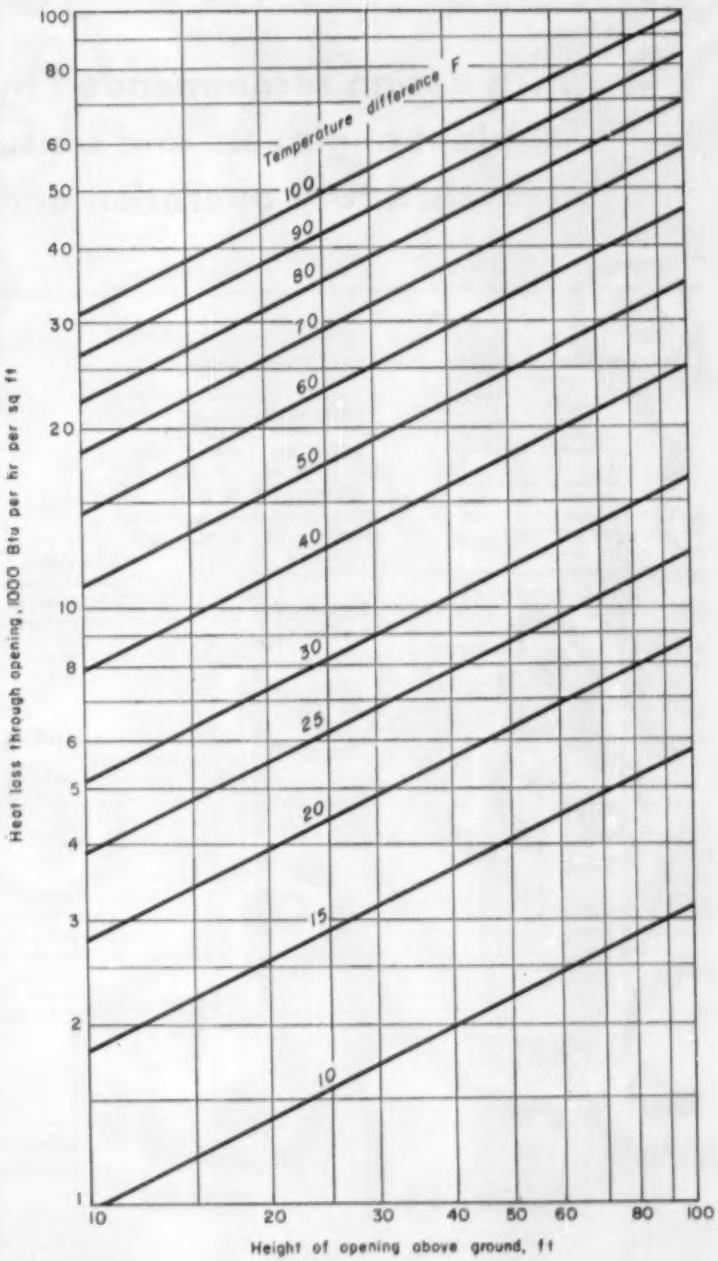
The chart makes no attempt to include the effects of wind or building tightness. These can alter heat loss quite markedly. Knowing the cost of heat you can figure what it costs to keep a window open during the heating season.

*Example*: A machine shop heated to 70 F keeps 100 sq ft of window open. The openings are 20 ft above ground. What is the loss when the outside temperature is 30 F? The temperature difference = 70–30 = 40 F. On the chart find 20 ft on the horizontal ordinate, follow up to 40-F curve, and read 11,200 Btu per hr per sq ft. Then total heat loss = 11,200 × 100 = 1,120,000 Btu per hr

We can translate this into dollars. Assuming heat costs $1 per million Btu, the loss would be $1×1,120,000/10⁶ = $1.12 per hr.

Now, assuming a 26-week heating season with an average 30-F temperature difference and a one-shift 5-day week, this open-window area could cost: 7,300×100×$1 (26×5×8)/10⁶ = $759 It's a figure worth trying to eliminate.

A H KOEPF *Seattle, Wash.*




**POWER pays $35 for each accepted Data Sheet. Why not submit yours today?**

# NOW . . . 26 million pounds of steam/hr. generated by RILEY units with the

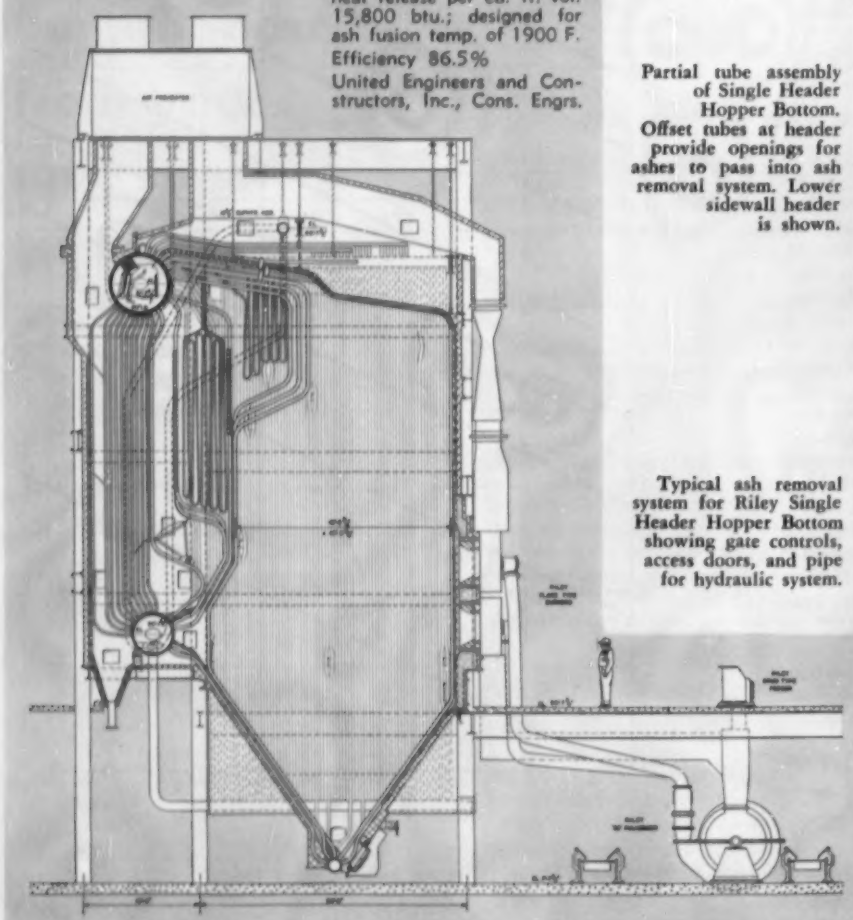
# *SINGLE HEADER HOPPER BOTTOM

**. . . a design recommended by scores of power plant engineers and consulting engineers for its satisfactory operation and money-saving features.**

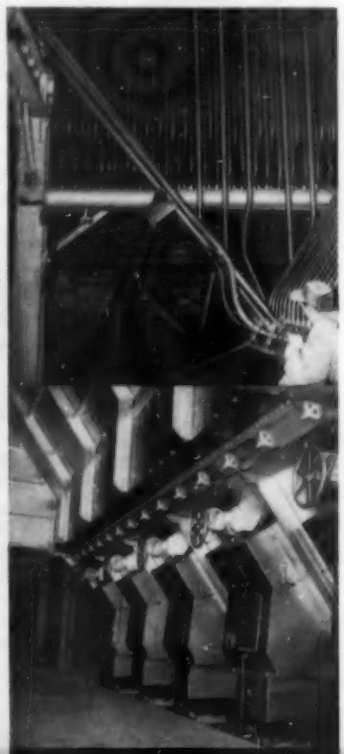
*Patented

**Western Electric Company Hawthorne Works, Chicago, Ill.**

Capacity 150,000 lbs/hr. 835 F/1000 psig; furnace heat release per cu. ft. vol. 15,800 btu.; designed for ash fusion temp. of 1900 F.
Efficiency 86.5%
United Engineers and Constructors, Inc., Cons. Engrs.



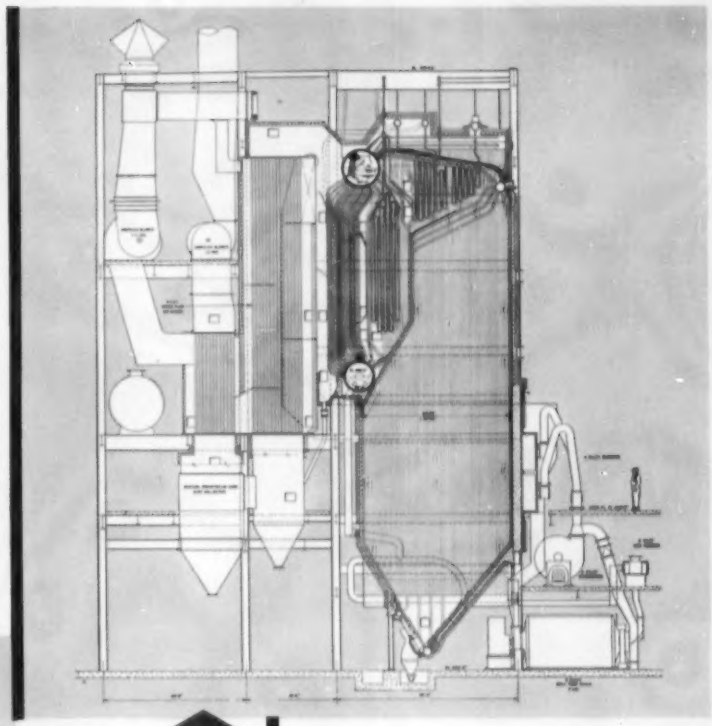
Partial tube assembly of Single Header Hopper Bottom. Offset tubes at header provide openings for ashes to pass into ash removal system. Lower sidewall header is shown.

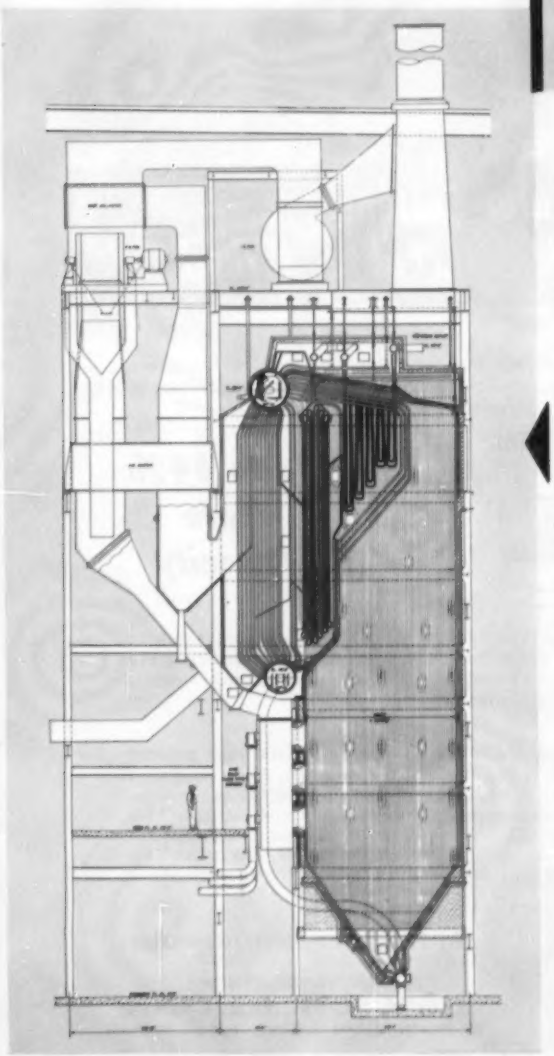


Typical ash removal system for Riley Single Header Hopper Bottom showing gate controls, access doors, and pipe for hydraulic system.

*Your nearest Riley Representative will gladly furnish you with further details about Riley Single Header Hopper Bottom installations, or write to Riley Stoker Corporation, Dept. A, Worcester, Massachusetts.*

- Successful with all types of high ash coals, even with ash fusion temperatures as low as 1900 F. No ash removal difficulties.
- Ideal for units firing a combination of coal, oil and/or natural gas, or, where coal may be used in the future.
- Integrated design eliminates the cost of separate hopper, and seals between unit and hopper with their maintenance.
- A convenient pneumatic or hydraulic ash removal system may be added.
- Reduces over-all building height . . . permits higher capacity unit in existing building.
- Adaptable to units of any capacity.





**Dairyland Power Cooperative**
**Cassville, Wisconsin**
Capacity 230,000 lbs/hr; 900 F/1000 psig; furnace heat release per cu. ft. vol.-19,300; designed for ash fusion temp. — 1980 F. Efficiency 86.0%
Vern E. Alden Co., Consulting Engineers.

**South Carolina Public Service Authority**
**Moncks Corner, S. C.**
Capacity 450,000 lbs/hr.; 900 F/925 psig; furnace heat release per cu. ft. vol.-17,000; designed for ash fusion temp. — 2150 F. Efficiency 87.7%
Ford, Bacon & Davis, Consulting Engineers.

**A few users of over 150 units sold**

Otter Tail Power Co.
Central Ohio Light & Power Company
Bird & Son, Inc.
So. Nevada Power Co.
Upper Peninsula Generating Company
Western Colorado Power Co.
City of Rochester, Minnesota
Central Electric Power Corporation, Linn, Mo.
Waldorf Paper Products, Inc.
Esso Standard Oil Co.
General Electric Co.
Allis-Chalmers Manufacturing Co.
Ohio Oil Company
Goodyear Tire & Rubber Company
Hooker Electrochemical Co.
North American Aviation
United Aircraft Company
Celanese Corporation
United States Steel
Syracuse University
U. S. Rubber Co.
White Pine Copper Co.
City of Holyoke, Mass.

**A few prominent consulting engineers**

Sargent & Lundy • Ebasco Services • Chas. T. Main • Day & Zimmerman • Rust Engineering Co. • Albert Kahn • Vern E. Alden • Gilbert Associates, Inc. • Sanderson & Porter • The Kuljian Co. • Ford, Bacon & Davis • Jackson & Moreland • Burns & McDonnell • Lockwood Greene • Stone & Webster • H. M. Wilson Co.

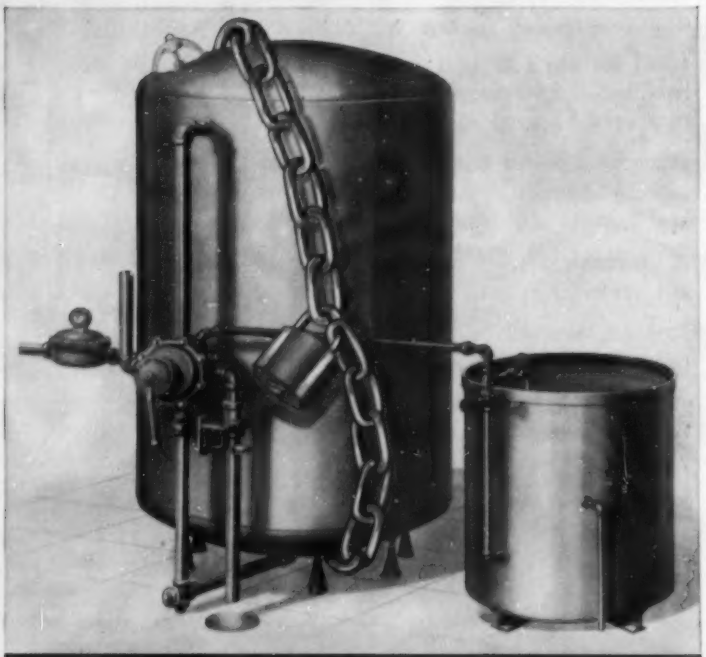
*A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.*

# RILEY
## Stoker Corporation
WORCESTER, MASSACHUSETTS

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

# Zeolite Costs Money

## ...why waste it?



***You prevent its loss when you use . . . The Water Softener with the Zeolite "locked in"***

Apparently the old idea in making water softeners was that the zeolite was expendable. That was an expensive idea even when zeolite cost much less . . . and of course it's still more costly today. Zeolite today represents an important part of your investment in a water softener. It isn't consumable; it's part of the capital investment . . . something to hang on to!

Loss of zeolite was stopped cold the day we introduced the "Double Check" water softener. This ingenious design truly "locks in" the zeolite. Prevention of zeolite loss during back-washing is an important feature that has become increasingly more important, *but* . . .

It's only the start of the story. Other water softeners using old-style manifolds are forced to use shallower zeolite beds to minimize escape of zeolite during backwashing. But the "Double-Check" softener can use more zeolite, and backwash it, and regenerate it, far more effectively. As a result it gives—

***Up to 44% More Capacity***

The diagrams tell the story. You get this extra output of soft water from the same size softener using the same type of zeolite . . . and you do it at lower operating and maintenance cost.

Sectional view of "Double-Check" Softener showing design which prevents escape of zeolite; permits deeper zeolite bed, better regeneration, greater output of soft water.

***The "Double-Check" can be built into your present softener.*** If your existing softener is in fairly good condition you can have the advantages of zeolite loss prevention and extra capacity at surprisingly moderate cost. This type of modernization, along with our high capacity zeolite, has stepped up soft water output three to ten times in hundreds of cases.

Elgin REFINITE SINCE 1908

***Write today for complete information***

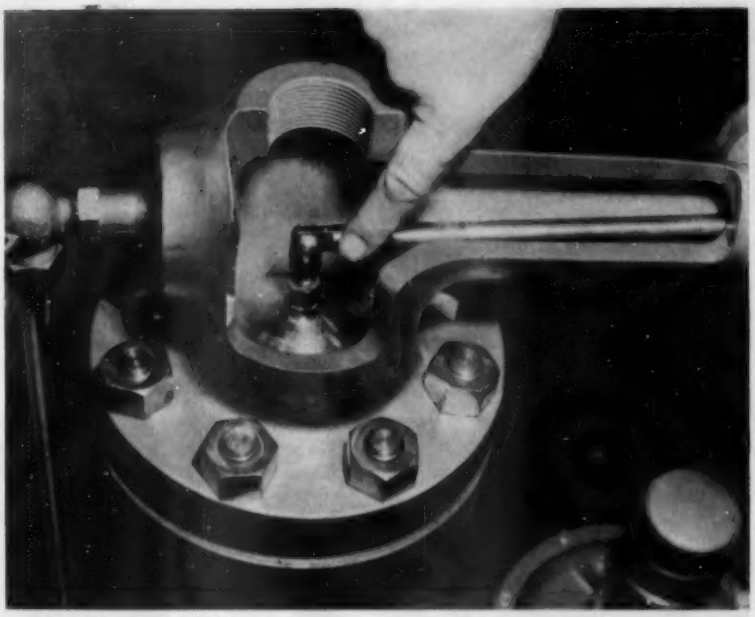
*ELGIN REFINITE DIVISION*

**ELGIN SOFTENER CORP.**

130 NORTH GROVE AVENUE, ELGIN, ILLINOIS

PLANT OPERATION and MAINTENANCE SECTION
MAY 1955

STEVE ELONKA
*Associate Editor in Charge*



**DISPLACEMENT CONTROLLER:** Cutaway shows up torque arm, displacer and housing

# Level controls: Know-how is your best bet for troublefree performance

***A host of power-service as well as production operations depend on accurate liquid-level control. Here's info on one of the most important types—displacement controllers***

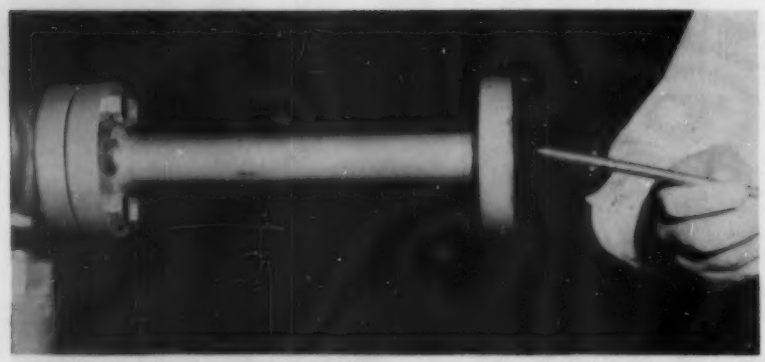
► THE PROBLEM: To keep liquid level within specified range, in your condenser hotwell, deaerator storage tank, feedwater heater or water-treating tank.

THE ANSWER: Displacement type of level controllers—learn how they work and hook them up right. And that's just what was done at recent maintenance-clinic sessions, run by John Vossler of Black, Sivalls and Bryson, Inc.

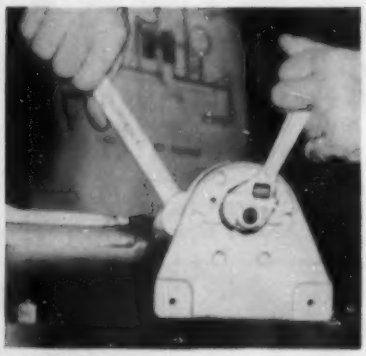
**How they work.** Three main parts of your liquid-level controller are (1) displacement element or float (2) torque tube (3) pilot. Let's start with the displacement element and trace out drawing on page 109.

The cylindrical displacer is heavy enough to sink in liquids up to 1.8 specific gravity—or higher for special applications. Basically, operation depends on the fact that any object (in this case, the displacer) weighs less when submerged. It's easy to figure just how much less. Just subtract weight of displaced fluid from weight of the object. Difference is the buoyant force. Floating happens when weight of the displaced fluid is equal to weight of the object. Displacement elements must never actually float. Element weight is, therefore, greater than liquid weight

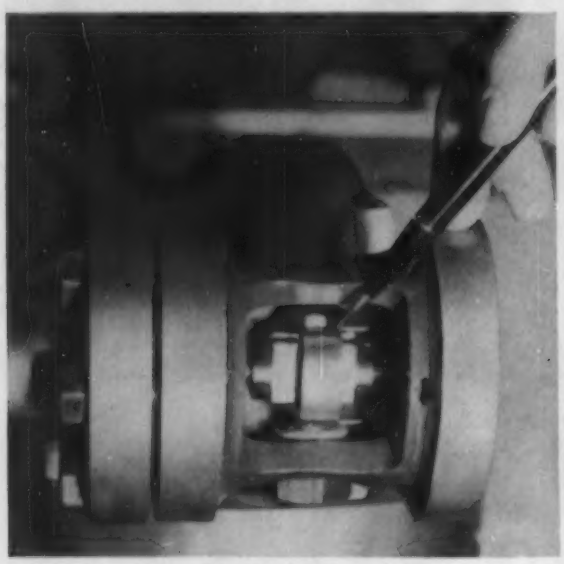
Based on sessions at 5th Instrument Maintenance Clinic, at University of Pennsylvania, sponsored by the Instrument Society of America.



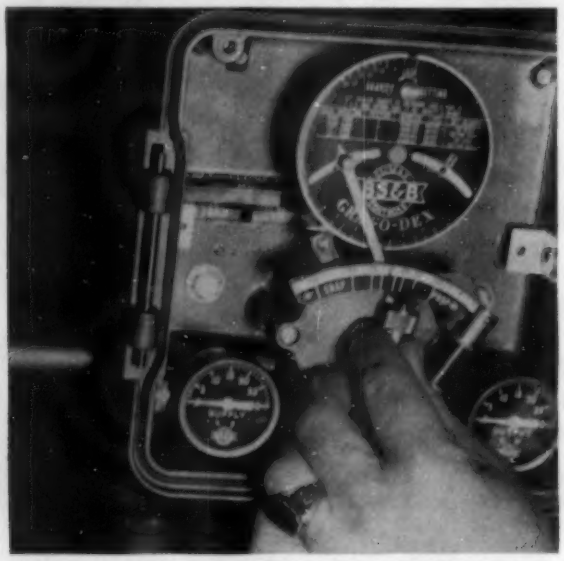
**TORQUE TUBE'S** free end is inserted in housing. When liquid level rises or falls, torque arm varies tube twist. Rod, inside tube, transmits liquid-level change to pilot



**ADJUSTING** torque tube to carry the dead weight of the displacement element



**C CLIP** and connector block hook the torque arm to the torque tube. This assembly keeps any friction to a negligible level



**PILOT'S** control action depends on relative positions of adjustable bellows and curved piece, to the bleed-nozzle valve

## Application decides whether you use proportional

displaced, when element is totally submerged.

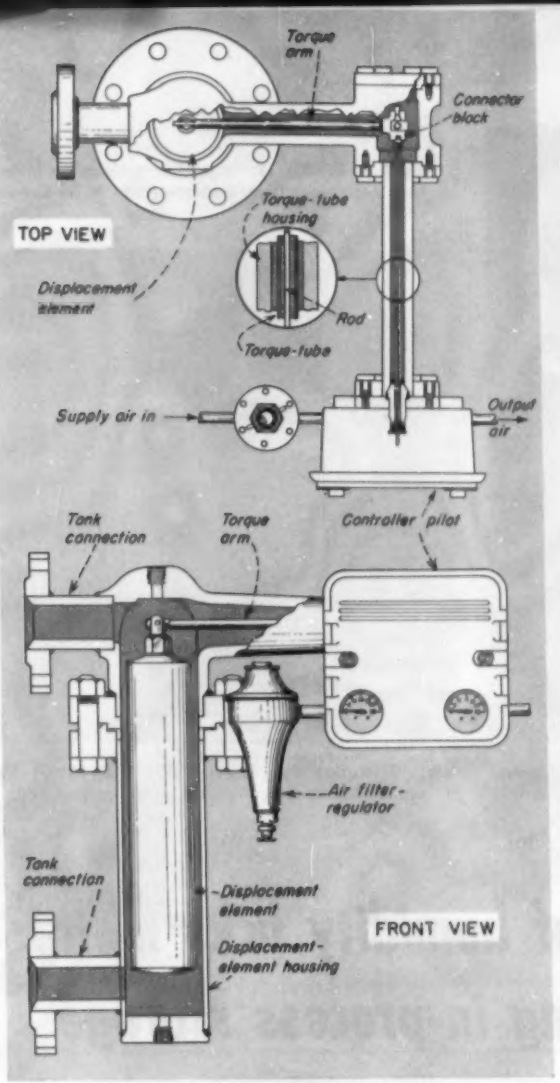
Heart of the level controller is the torque tube. One end of this hollow-shaft unit is fixed (end connected to pilot). Opposite end is free to turn. Torque arm extends at right angles from free end of the torque tube, connects to the displacement element. Weight of the displacer thus exerts a twist on the torque tube by leverage of the arm. As liquid—in which the displacer is suspended—rises, displacer weight reduces. Greater buoyant force, naturally, relaxes twisting action on the torque tube. If liquid level drops, twist increases. So motion of the torque tube is proportional to rise and fall of liquid.

To complete the picture, tube movements must be translated into control-air pressure changes at pilot outlet. Air signals, from pilot, can then stroke a valve, connected to tank whose liquid level you're controlling. Result: Change in flow through control valve brings liquid level within set limits.

But since the torque tube itself is fixed at the pilot end, we must still find a way of actually getting tube twist to affect pilot's air output signals. Note, in drawing, that a thin rod is welded inside the torque tube's free end, running full length of the tube and extending into the pilot. Ball bearings support this rod at the tube's fixed end. Rod thus transmits tube twist to pilot.

**Pilot operation** depends on converting rod's motion, through a linkage, to air-pressure changes. Air-bleed nozzle valve and orifice, shown being adjusted in photo above, is throttled by linkage in proportion to rod's rotation. Throttling action relays pressure change to diaphragm, in pilot, that governs air signal to your flow-control valve.

**Proportional band** is the percentage of total displacer motion needed to vary pilot's pressure output over its full range—usually 3 to 15 psi. This pressure change will stroke most flow-control valves from open to closed—unless you've set valve with mechanical stops. If pilot is set at 50% proportional band, using a 14-inch displacement element,




**CUTAWAY VIEWS** of displacement-type liquid-level controller. Displacer can be mounted directly in tank, or in housing

## or snap-action control setting

you'll get 7-inch maximum variation in liquid level. Valve movement is proportional to pilot's air signal. Avoid making limits narrower than actually needed by the operation you're controlling. Excessively narrow limits may cause continuous cycling, won't let control valve settle down. If in doubt, discuss specific needs of your operation with controller manufacturer.

**Snap action**—on-off action—may be your best bet under some conditions. When you set pilot in this position, control valve doesn't move until liquid level reaches its upper or lower limit. 25% snap action, again using 14-inch displacer, strokes your control valve at high and low limits of a 3½-inch-wide band. But no valve motion takes place while liquid level is within the band.

Typical application for snap-action is control of slurry mixes. Slurry may erode control valve when it's partly open. So we want control valve to be fully open or fully closed.

**Specific gravity.** Find out or measure liquid's specific gravity. Then make sure gravity setting on pilot is right. Make necessary corrections when there is no liquid in contact with the displacement element.

**Trouble shooting.** Simple, rugged construction of displacement-type level controllers keeps maintenance to a minimum. But here are items to check when you install the unit, or have reason to doubt liquid-level control accuracy.

Good control starts with the displacement element. So make sure that it hangs vertically. If it's installed inside tank, check clearances. Displacer shouldn't touch tank walls, baffle plates or any object that could keep it from responding freely to liquid-level changes. If element is placed in turbulent liquid, you'll get poor control.

During routine maintenance checks, clean out dirt and sediment in displacer cage or tank itself. These accumulations, if allowed to build up, can block free displacer response. While you're making this visual inspection, examine all parts for corrosion or chemical deposits that may be present.

Torque tube can become over-stressed from continuous operation at high temperatures, fatigue action or careless handling. When this happens, your controller *plays dead*. To reset torque, rotate tube assembly until displacer clears bottom stop when housing is free of liquid. Caution: Make sure that torque arm doesn't bind at top of housing. Element must always hang free—even when it's fully submerged.

If you're replacing a displacement element, and plan to make the new one yourself, find out from manufacturer how much it should weigh. Wrong weight will, naturally, give you errors in control action.

**Pilot maintenance.** You'll lick many pilot troubles before they start by using clean, dry supply air. Make sure you've hooked up a filter at the pilot air-supply connection.

Pilots that work on the nozzle-bellows principle have one or more small orifices. These can become plugged with dirt or liquid—preventing air passage. If this happens, supply pressure gage may give normal readings, but outlet pressure won't build up. Remove orifice assembly and clean it with a fine soft wire or other recommended device.

**Sluggish pilot action** may be due to ruptured or fatigued bellows. If pilot is set for snap action, pressure won't build up and drop off quickly. It will change gradually. If pilot is set for proportional control, you'll note full pressure build-up. But pressure then drops to zero—instead of staying within upper and lower limits. Maximum pressure on bellows should never be greater than full-scale reading of output-air gage.

Pilot power unit is diaphragm-operated. You can detect stiffening of diaphragm by sluggish pilot action. Installing pilot in a high-temperature area will also affect diaphragm. Stiff diaphragms may even be affected by weather changes, give control during the day different from that during evening.

(*Continued on page* 208)

1 Dehumidification coil is located below a 20,000-cfm unit heater, which handles between 0 and 100% outside-air flow

By A M BEEBEE JR, *Supervisor, Building & Utilities Section*
*Plant Engineering Dept, Rochester Products, Div General Motors*

2 Refrigeration compressors, 20- and 15-ton Freon units, are automatically controlled by the storage-area humidistat

# Smart control of humidity licks metal corrosion during in-process storage

► GROWING DEMAND for increased production of welded and brazed steel tubing at Rochester Products, Division of General Motors, is responsible for three distinct expansion programs during the last six years. Each required the design and construction of a new and larger dehumidified area for the temporary in-process storage of steel tubing.

**Dehumidified area.** Need for this type of storage is based on the company's desire to offer immediate delivery, as well as to effect the cost savings of mass production. For this program, a certain portion of in-process bulk material must be stored to allow fabrication mills to operate on fixed monthly schedules. This gives minimum possible setups and an ever-moving bulk-material supply to meet customers' tubing needs.

**Corrosion.** Producers and users of plain, uncoated-steel in-process material are well aware that corrosion can be pronounced and very damaging in a matter of hours, especially during humid summer months. Occasionally, applying a protective coating like copper plate or terne is a secondary operation. So brief storage of plain steel tubing is required.

Tests at Rochester Products showed that an area with a relative humidity of 40% or less is needed for safe storage of its steel. Later results proved these tests were correct.

**Storage building.** In 1948, a single-story building, 80x200 ft, was built, specifically designed for products storage. A monorail conveyor connected it through an enclosed overhead bridge to the manufacturing building. It received detailed dehumidification engineering based on available design data.

In later installations, past experience and an effort to be as economical as possible resulted in some changes from the original design.

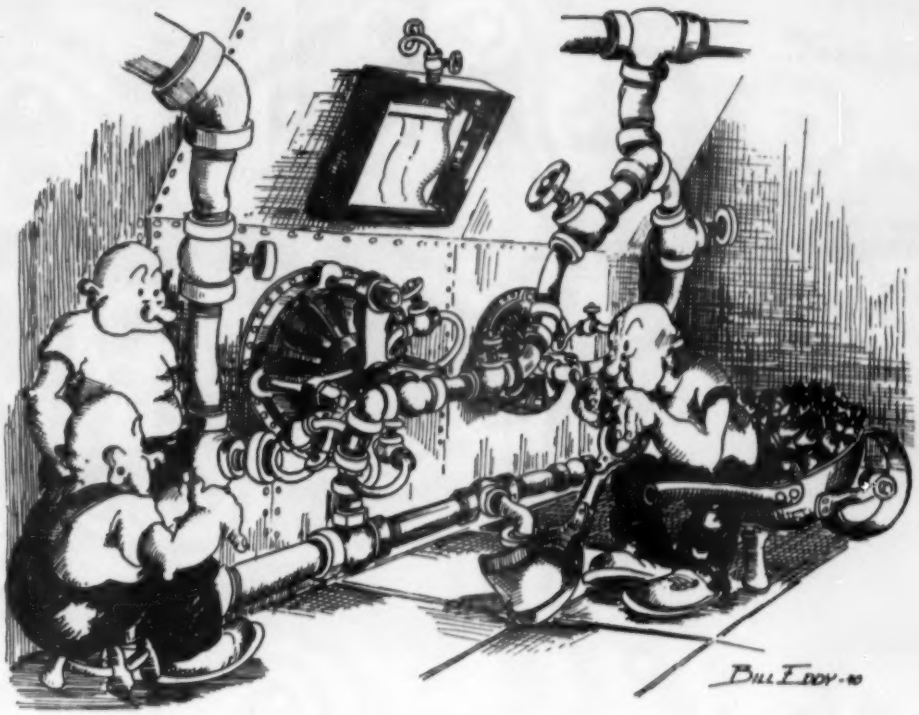
**Equipment.** Various dehumidification processes were considered but, among other reasons, a desire to gain experience with direct-expansion Freon units dictated choice of this type. Steel tubing has wide application for refrigeration condensing coils.

A 25-ton unit and evaporative condenser, along with its ducts, were installed in this building. The equipment ran until 1951 with highly satisfactory results. Even under the most acute weather conditions, it was not loaded to full capacity.

**Plant addition.** In 1951, a new building of 272,000 sq ft was added. Designed for the manufacture of steel tubing, a 120x220-ft area was provided in the corner for in-process material. Because a slight positive pressure in the room was desirable, no special attempt was made to tightly seal it from the remainder of the building or the outside.

An outside-air-supply unit heater, capable of handling 20,000 cfm at any setting between 0 and 100% outside air, was installed in the room. This arrangement insures that any air flow will always be out of the room. Di-

**No. 11 of the Bill Eddy cartoons**




"Clancy says it ain't romantic like it used to be in the old days"

rectly below this heater is a 9000-cfm air-handling unit fitted with 20- and 15-ton cooling coils arranged to operate constantly, Fig. 1.

The coils are served by 20- and 15-ton Freon compressors, Fig. 2, with a single double-receiver 40-ton evaporative condenser.

**Humidistat** controls the entire system, operating a 3-step controller which, in turn, actuates the two solenoid valves on the liquid lines to the coils. The first step opens the solenoid valve on the 15-ton coil; the second closes it and opens the valve on the 20-ton coil. Third step opens both solenoids, putting the unit on full load.

Compressors operate completely on the high- and low-pressure cutouts. A pressure switch controls the evaporative condenser. It is located on the hot-gas header between the compressor discharge and evaporative condenser.

**Hydrochloric acid,** used as a cleaning agent prior to terne coating, is present in traces in the general manufacturing area. This acid, if it reached the storage area, could increase the corrosion rate tremendously—even to a much greater extent than moisture. Pressurizing the storage room over the requirements imposed by dehumidification gives a positive means of preventing acid fumes from entering.

Note that although room size increased by 284,000 cu ft, only 10 tons of refrigeration were added to the original equipment. This additional capacity was based on plant operating data plus engineering judgment, while design conditions of 40% relative humidity were maintained.

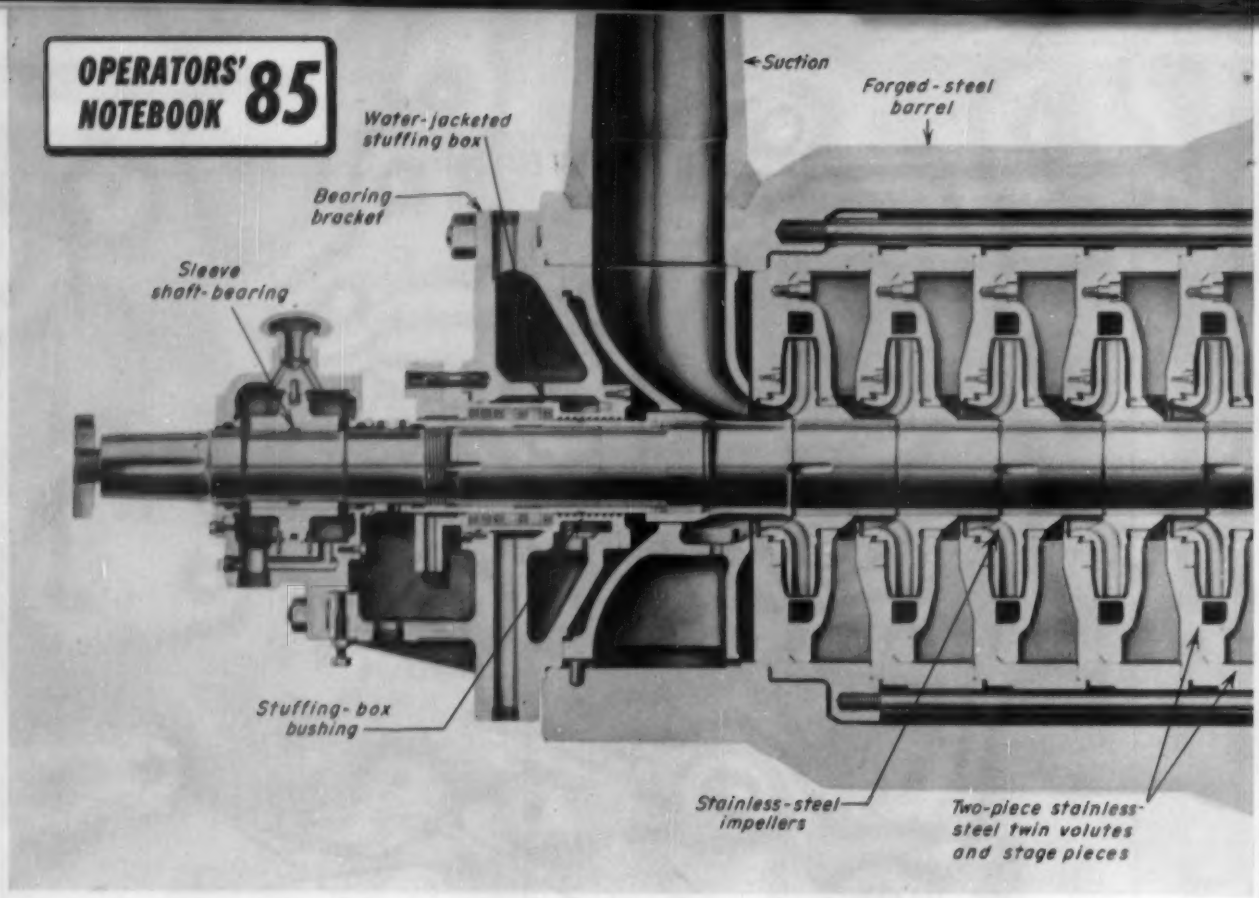
A $6000 saving was made by not using ducts. Testing the equipment without ducts showed the desired humidity could be maintained over the entire room area.

**New space.** An additional 252,000 sq ft of manufacturing area is now being built for the second plant. In-process work will be stored in a new room having an area of about 50,000 sq ft. To serve this the 35-ton installation will be relocated and used without ducts.

Since the major entrance of moisture is through the 20,000-cfm unit heater, the addition of another 35-ton coil in this heater is being considered. If used, all incoming air will be dehumidified before it enters the controlled space. The storage room will have a positive pressure, as before.

**Acid removal.** To relieve the concentrations of hydrochloric acid in the atmosphere at their source, about 450,000 cfm of fresh air will be uniformly supplied to the perimeter of the 400x300-ft manufacturing area where acids are used. This entire volume will be exhausted by 20 roof exhausters, over the contaminated area, discharging vertically. This arrangement is expected to completely dissipate the contaminating gases to the atmosphere and eliminate their spread through the plant. Satisfactory conditions are expected in the manufacturing area in the plant.

**OPERATORS' NOTEBOOK 85**




# Now let's open, inspect and overhaul

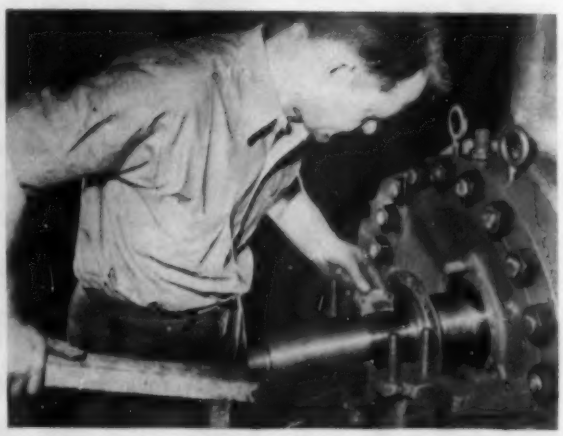
► IT WILL HELP YOU understand all pumps so much better if you know construction details of a high-pressure boiler-feed pump, and how to inspect and assemble it, even though you don't have this type of unit yourself. Modern double-case barrel-type centrifugal pump is today's answer for pressures up to 6000 psi, to 1000 F. In the common 2600-psi range, this type runs at about 3600 rpm, has up to 12 stages.

Long service without major overhaul is common for these pumps. But when you do open one, do your job thoroughly because this unit is vital to plant operation. Photos show every important step. They should guide you to do the job right, even if you have never opened your pump before.

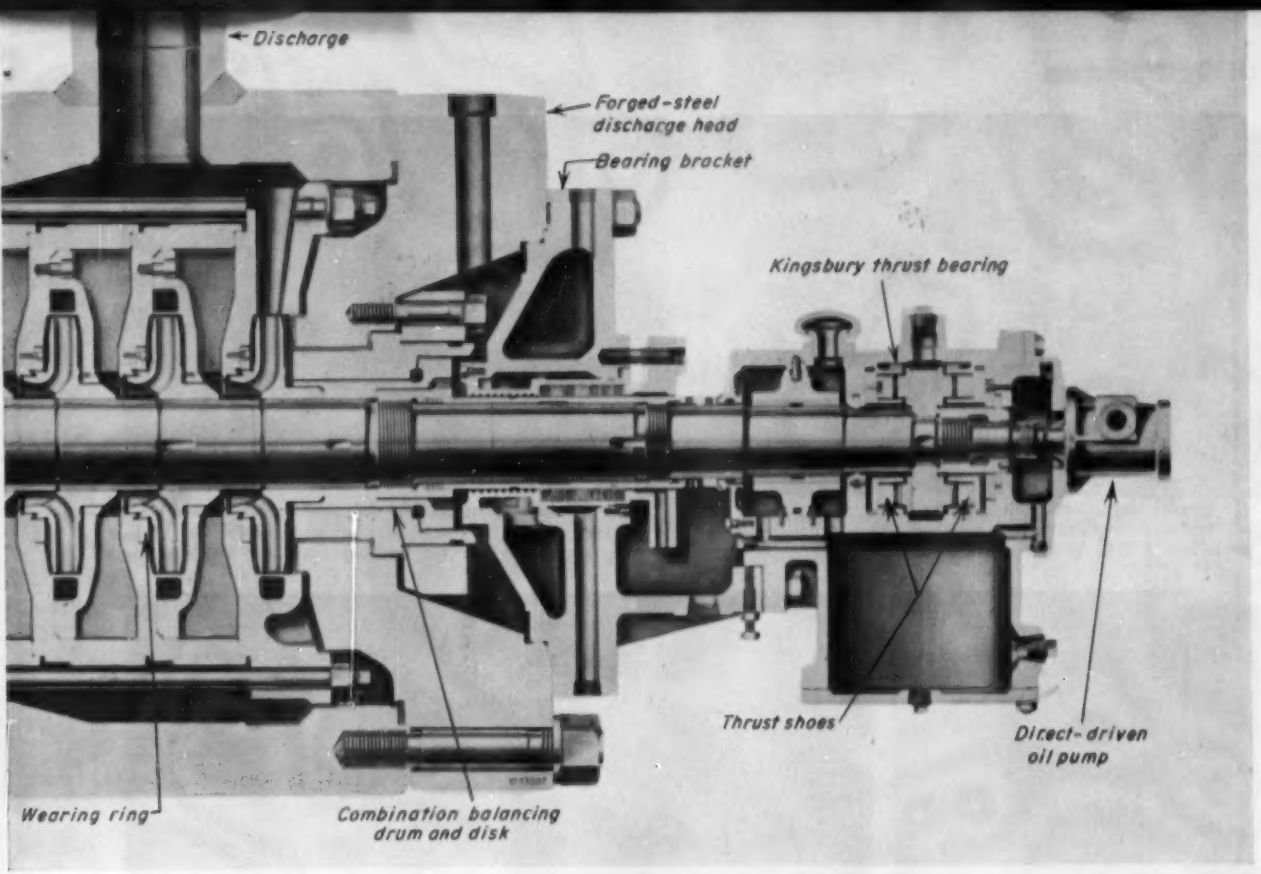
Pump overhauled here is a Worthington, 9-stage unit, with discharge diameter 8 in., designed capacity 657,000 lb per hr, suction pressure 102 psi, discharge pressure 2582 psi, suction temperature 320 F, speed 3500 rpm, driven by electric motor through hydraulic coupling.

We start right out by overhauling pump parts shown in cross section at top of page. Of course, oil lines and other piping connections are disconnected. Here we show only major pump parts that you will have to give special attention.

## 1 Here's how to open

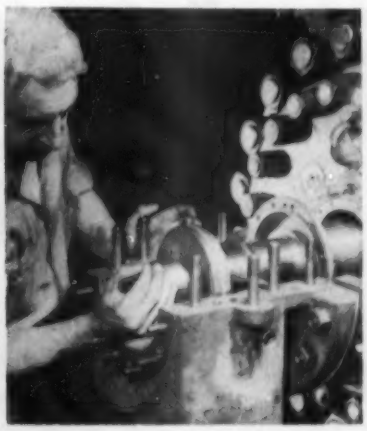


1 Remove coupling, gland, packing, then bearing cover on inboard end. Next, take weight off lower bearing bushing as shown, roll out the bushing by sliding it up over the shaft. With load off bearing housing, you can unbolt and remove it

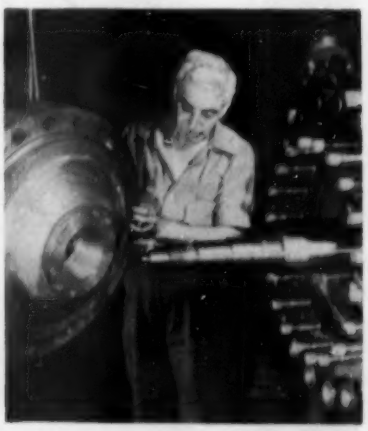



# this barrel-type feed pump in 3 steps

**2** Now let's switch to the outboard end. Remove direct-driven oil pump and bearing cover. Remove thrust shoes, roll out leveling plate and the base ring



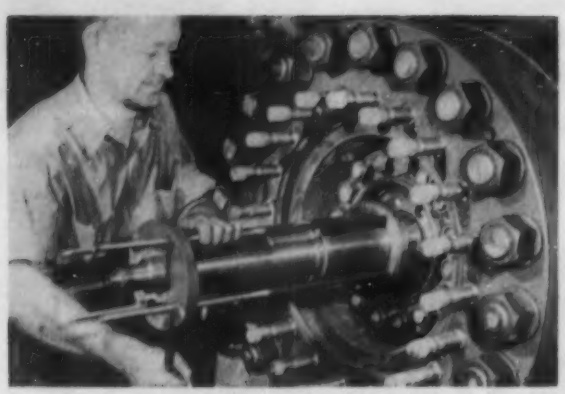
**3** Screw off the thrust collar-nut by first loosening with special wrench. Now slide thrust collar off shaft. Next, remove the bearing so shaft is clear



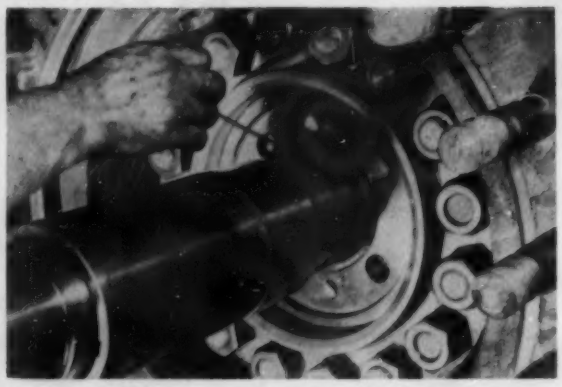
**4** Remove nuts from outboard bearing bracket. Fasten wire sling to eye-bolt and swing bearing bracket clear of shaft. Guide so it does not touch shaft



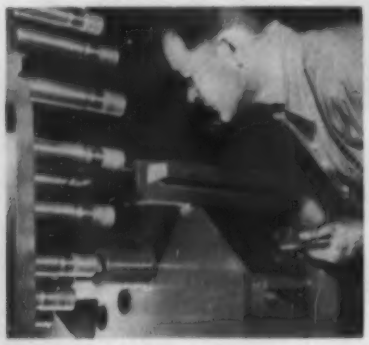
*Turn page to finish first step*



**5** Special tools come with all barrel-type feed pumps. Set tool up on shaft to remove the shaft sleeve as here. Tighten each nut a little until the sleeve starts to move on shaft

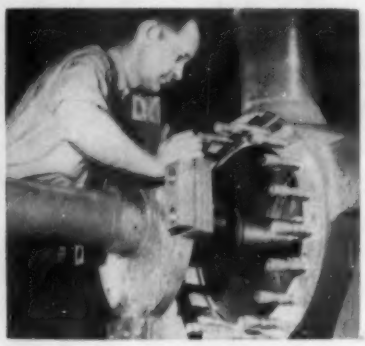


**6** Remove shaft-sleeve packing with packing hook. Aim hook at stuffing-box bore—not at shaft as hook will scratch it. Always remove all the old packing from any stuffing box



**10** Move rotor carriage, raise or lower with hand wheel to align with casing studs. Lock it in place with two nuts

**11** Place the carriage crosshead over the shaft at discharge end of pump. Screw crosshead onto the locking nut



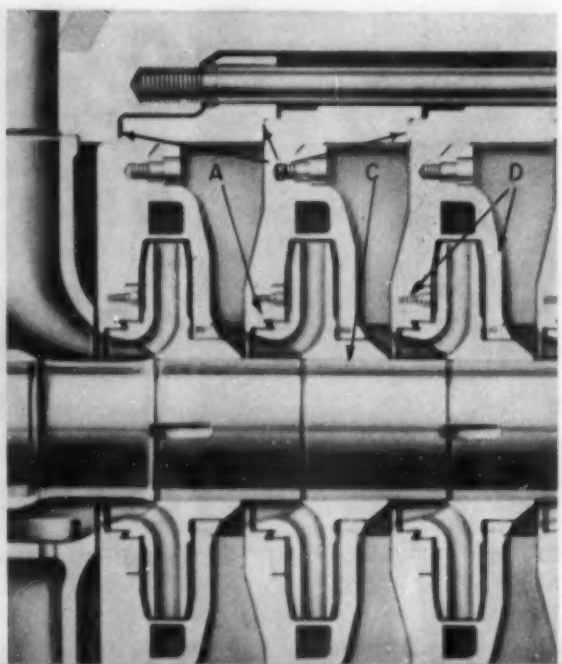
**12** Next, slide the special inboard shaft support-head and shaft protecting sleeves over the shaft, bolt in place

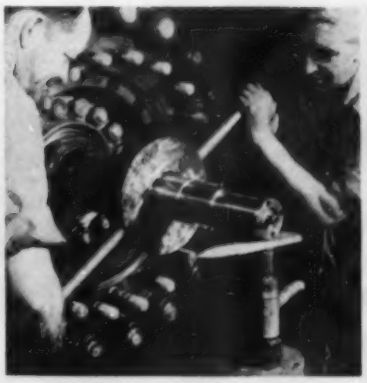
**15** Heat each impeller to 300 F to expand over shaft. Keep moving torch. Use special clamp to lift the impeller

## 2 And here's how to inspect

**YOU MUST WATCH THESE DETAILS WELL**

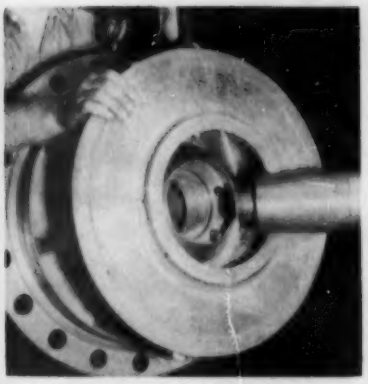
**A:** wearing rings for wear, clearance
**B:** metal-to-metal joints for mating
**C:** impeller for a good shrink fit
**D:** 2-piece twin volutes and stage pieces' condition
Compare clearances with those of manufacturer





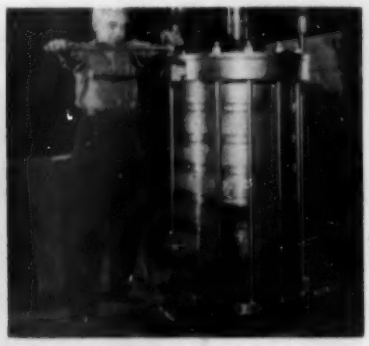
**7** Remove balancing disk from supported shaft with special wrench. *Never* turn rotor if bearings are out

**8** Next, remove nuts, swing discharge head clear. Remove stay-bolt nuts, washers, keys (small nuts in cylinder)



**9** Remove nuts from discharge head at other end, take weight with chain fall. Guide carefully, swing clear of shaft

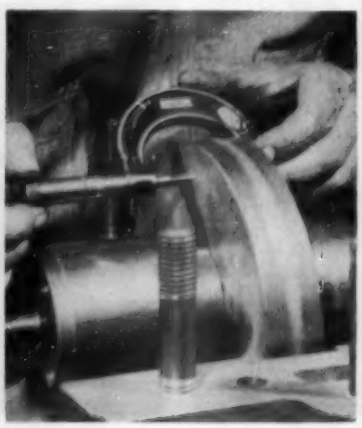
**13** With carriage bolted to two cylinder studs, slide out pump's inner assembly. Two mechanics can easily do this job by turning pinions over the pinion rack on each side of carriage. Heavy rotor is easily moved thus to any part of your plant



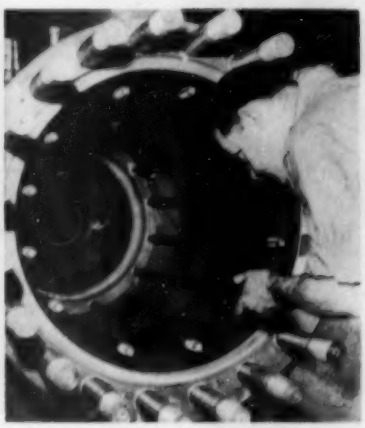
**14** Lift rotor assembly off the carriage with crane and place vertically on wooden blocks. Remove the stay-bolt nuts

---

**1** Examine thrust shoes carefully. Wear should be very little as relocating balancing device takes the thrust load



**2** Mike thrust collar for wear. There is usually little or no wear here as softer babbitt on shoes takes wear



**3** With rotor assembly removed, inspect the inside of the barrel thoroughly. Look for signs of erosion, dirt, scale



*Continue second step on next page*

**4** Measure ID of interstage bushing balancing-disk, wearing rings and OD of mating parts. Renew bushings if clearance is about double that in the manufacturer's instruction book

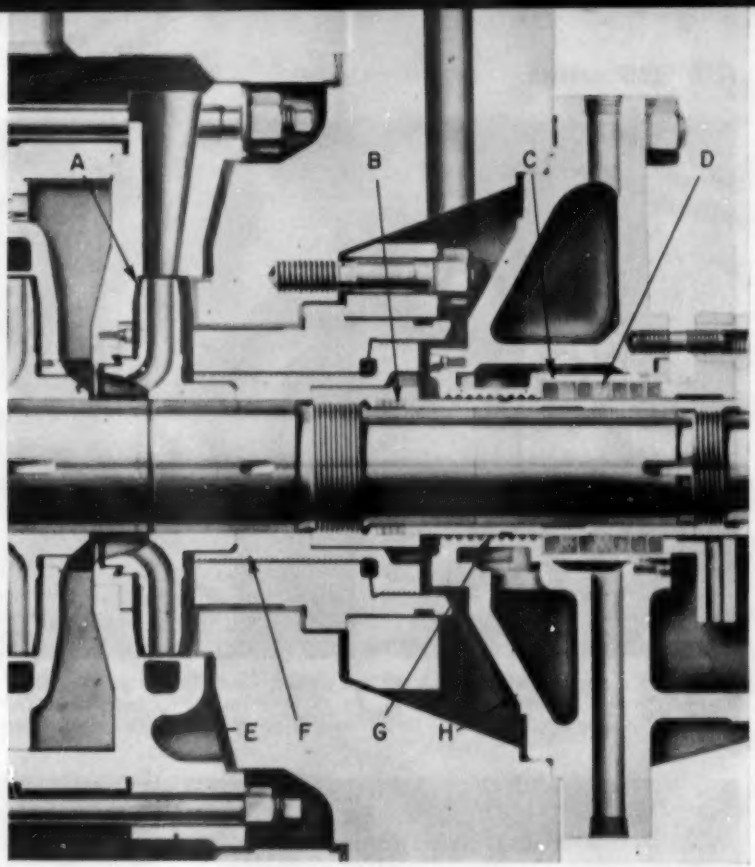
**5** Place impeller in stage piece, move laterally against a dial indicator to see diametral clearance. Compare this reading with data given in your manufacturer's instructions

**6** Now install twin-volute diffuser and repeat the process to determine diametral clearance in interstage bushing. Compare this with the data given by the maker of your pump

**7** Inspect impeller bore carefully. Since the impeller is shrunk on the shaft and keyways do not cut through, there should be no sign of leakage here. But check carefully anyway

**8** Check the tongue of the volute carefully for any signs of erosion. Volutes are of stainless and usually this is not a problem. But don't overlook anything while the pump is open

**9** Check metal-to-metal joints between stage pieces for signs of erosion. Since stage pieces are stainless, this is usually not a problem either. But, again, don't miss anything




**HERE'S DISCHARGE END**

**A:** 9th-stage impeller **B:** sleeve seal
**C:** water-jacketed stuffing box bushing
**D:** packing set **E:** last-stage diffuser
**F:** balancing-disk head
**G:** shaft sleeve **H:** bearing bracket

Please note: This is the high-pressure end of the pump. Make sure you know these details. Give each part your careful attention for long troublefree service

# 3 Now let's close it up right

**1** To expand over shaft, heat impeller with flame if lacking an oil bath. Here hot plate distributes heat evenly

**2** Slide heated first-stage impeller in place. Make sure that bearing surface is coated with molybdenum disulfide

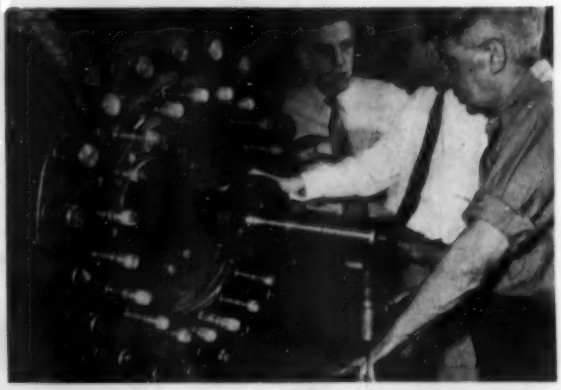
**3** Blow compressed air through hot impeller to cool. Parts are numbered. Fit into the right position on the shaft

*Next spread finishes third step*

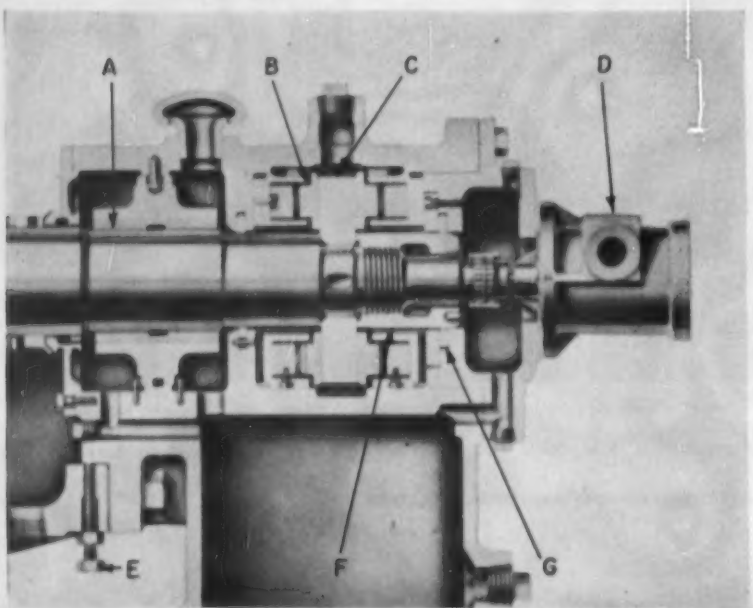
**4** With first-stage impeller shrunk on shaft, mount assembly vertically in first-stage stage-piece, as shown here

**5** Next, install first-stage twin-volute diffuser in stage piece. Shaft is machined slightly smaller for each successive impeller. Joints are metal to metal, so be sure to get them perfectly clean before mating or you might run into some trouble

**9** Thoroughly clean metal-to-metal joint, between discharge head and casing barrel, with crocus cloth. Tight joint here is important, depends on perfect contact of mating surfaces



**10** As Frank Anderson, *right*, installs balancing disk with special wrench, Editor Steve Elonka and Ted Edwards of Worthington Corp, *left*, look on. Shaft is on hydraulic jack

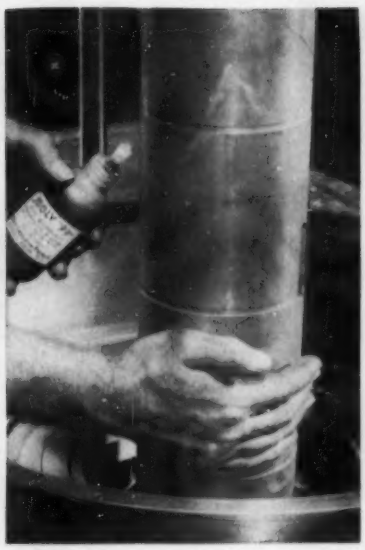



**BEARINGS ARE IMPORTANT**

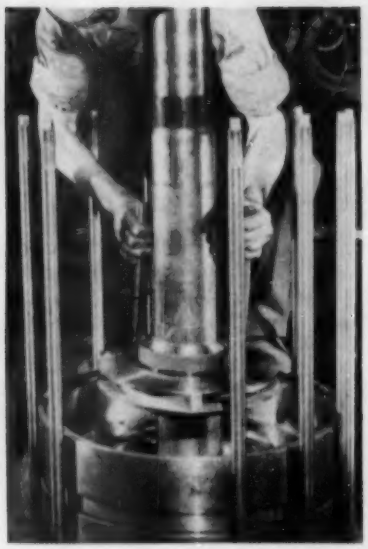
**A:** bearing bushing **B:** thrust-bearing shoe
**C:** thrust collar **D:** oil pump on shaft
**E:** jacking screw for centering the shaft
**F:** thrust-collar nut **G:** thrust sealing ring

Editor's note: *For information on diagnosing pump ills so you know when to open a pump of this type, turn to page 86 in the E&M section of this issue*

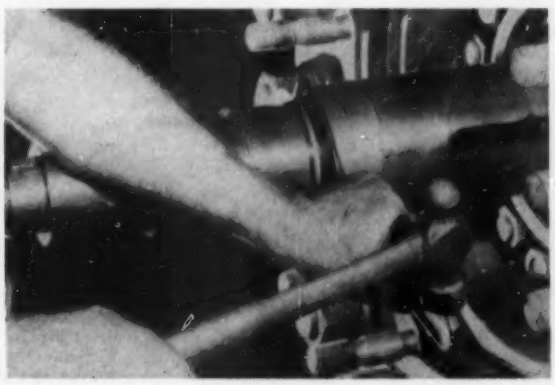
**6** When replacing wearing ring in stage piece, always lock Allen setscrews by upsetting with center punch as here



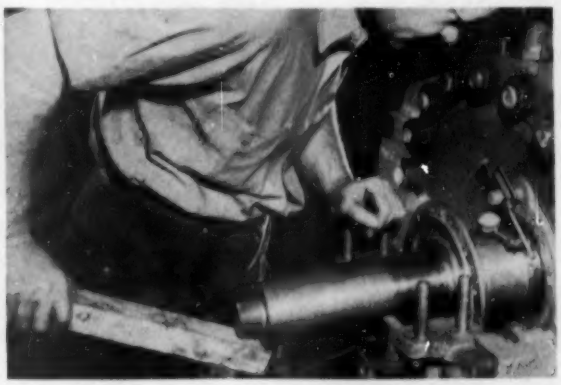
**7** Put molybdenum disulfide on bearing surface before shrinking impellers in place to prevent galling next overhaul



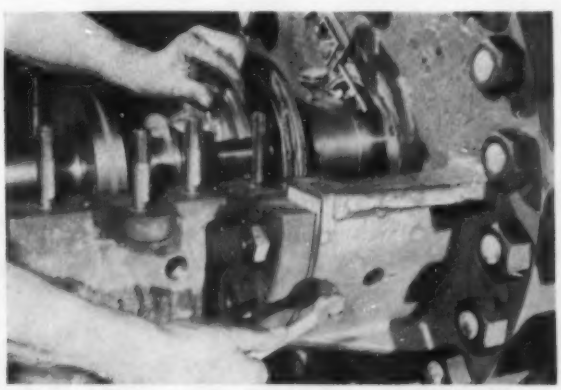
**8** Install subsequent stage pieces, impellers and the twin-volute diffusers until the complete rotor is assembled



**11** With rotor assembly in place and pump casing ready to close up, install shaft sleeve and tighten shaft sleeve-nut with spanner wrench. Sleeve takes all the packing wear

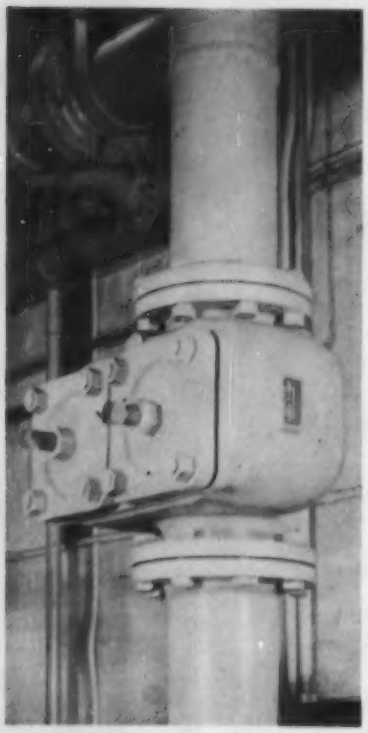


**12** Check the vertical movement of shaft in wearing rings and diffuser bushings by jacking up on the shaft against dial indicator. Refer to recommendations for the maximum clearance



**13** Bolt thrust-bearing housing in place, install lower journal bearing-bushing. Adjust jackscrews on housing sides for total vertical clearance, split in half to center shaft

**14** Pack pump, assemble oil and cooling-water lines, drains. *Caution:* Before starting overhauled pump, always roll pump by hand while cold, also afterward warm with suction open



1 Air check valve in discharge line of a 960-cfm duplex air compressor

2 View of a 12-in. circular-disk-type check valve, showing interior details

***Do noisy operation and pipe vibration make your air-compressor plant a miserable place to work? Then . . .***

# Let check valves iron out

► USING A CHECK VALVE in the discharge line of an air or gas compressor to replace the customary globe and safety valves can give several operating advantages. But the check valve must be specially designed for air or gas service if best results are to be secured.

**Valve function.** The check valve (1) prevents air leakage through the compressor during the off cycle (2) dampens pipe pulsations (3) eliminates the danger of compressor operation with the globe valve closed and (4) where more than one compressor is on the line, permits repair to any unit without shutting down the system.

Since operation of a check valve is entirely automatic, its use simplifies compressor start-up and shutdown. While no valve is completely maintenance-free, a correctly designed discharge check valve has long life and needs little routine care.

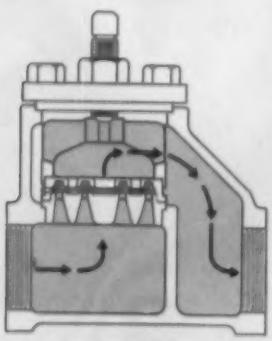
**Pulsation.** Pressure surges, in a compressor discharge pipe, result from the action of the pistons and valves that induce air- or gas-stream pulsations. These are transmitted to the piping. But unbalanced forces set up by reciprocating and rotating parts of the compressor and its drive may also cause piping vibration if the various parts of the system are not properly isolated.

Discharge check valves, when properly designed and applied, damp, fractionate and disrupt pulsations. Attendant noise, often a source of many complaints, can be almost completely eliminated. Tank ring is reduced, making the entire system less noisy. Pipe vibration, caused by transmission of compressor movement or unbalanced forces, is a mechanical problem and cannot be solved by a pneumatic device like a discharge check valve.

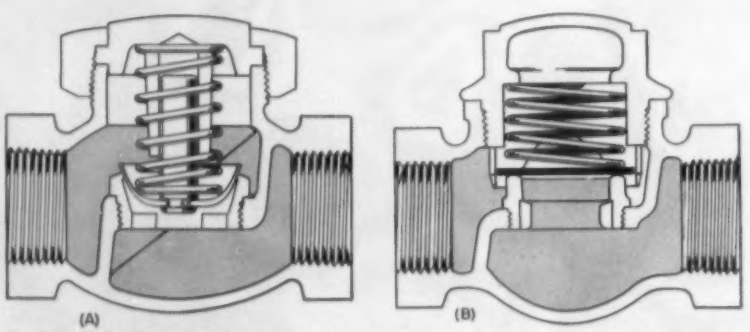
**Valve designs.** A number of designs have been used for valves intended to prevent backflow of air or gas in a compressor discharge line. A few are shown on these two pages.

The air check valve, Fig. 1, 2 and 3, has ring-plate-type stainless-steel circular disks housed in a cast-iron or steel body. Made in sizes from 1 through 12 in. for pressures to 600 psig and temperatures to 350 F, this valve is widely used as a check and for pulsation and noise reduction.

As shown in Fig. 3, air or gas discharged by the compressor enters the valve on the underside of the disks and flows upward. Air pressure, acting on the disks, holds them off their seats. When the compressor stops or is unloaded and air flow ceases, the springs above the disks cause them to seat, preventing backflow from the discharge line through the compressor.



3 Cross section of circular-disk-type air check valve, showing flow path




4 Two bronze-body stainless-steel disk check valves for air service. Valve *A* has a conical disk, while that at *B* is flat. Both disks are spring-loaded, as shown

By E ROBERT GRAUERT
*Pennsylvania Pump and Compressor Company*

# air-line pressure surges, cut noise

During passage through the valve, pressure surges are suppressed, giving smoother flow in the discharge line. This, in turn, reduces discharge noise and tank ring. Valves of this design may be installed horizontally or vertically, or in any other position, without hindering operation.

**Location.** To insure best results, it is important that a valve of the design in Fig. 3 be the proper distance from the compressor cylinder. Table below summarizes usual distances for this design.

| *Line size in.* | *Distance from cylinder, ft* |
|---|---|
| ½ | 1 |
| ¾ | 1.5 |
| 1 | 2 |
| 1¼ | 2.5 |
| 1½ | 3 |
| 2 | 4 |
| 2½ | 5.5 |
| 3 | 6.5 |
| 4 | 8.5 |
| 5 | 10.5 |
| 6 | 12.5 |

These valves must always be installed between the discharge from the compressor and the receiver. Where an aftercooler is used, install the valve between compressor and aftercooler.

**Capacity.** Amount of air that flows through this type valve with a given pressure drop varies with the pipe size and air pressure at the valve inlet. Table below gives typical capacities at two common pressures.

| *Pipe size* | Cfm free air with 0.37-psi pressure drop | |
|---|---|---|
| *in.* | *At 30 psig* | *At 100 psig* |
| 1 | 6.75 | 11 |
| 1½ | 22 | 35.5 |
| 2 | 43 | 70 |
| 2½ | 68 | 111 |
| 3 | 123 | 200 |
| 4 | 252 | 410 |
| 5 | 458 | 745 |
| 6 | 728 | 1185 |
| 8 | 1535 | 2500 |
| 10 | 2810 | 4570 |
| 12 | 4500 | 7320 |

**Other designs.** The conical-disk valve, Fig. 4*A*, is designed for pressures to 500 psi. It is said to have a self-cleaning action with every pulsation in air pressure. The disk is a special stainless-steel alloy. Another design, Fig. 4*B*, has a stainless-steel flat disk with a bronze seat ring.

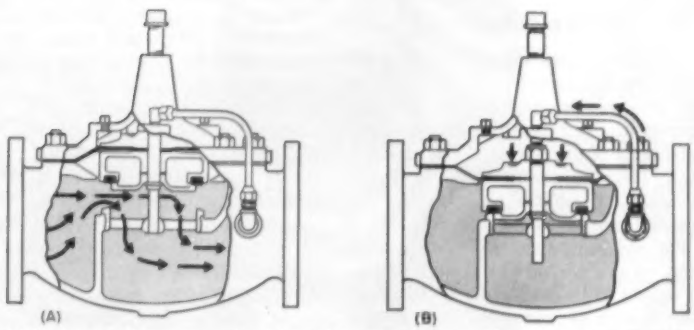
The valve in Fig. 5 opens and closes at a controlled rate to prevent slamming, fluttering or pressure pulsations. As shown in Fig. 5*A*, this check valve opens when the pressure at the inlet exceeds the discharge pressure. The disk lifts from its seat as the fluid in the cover chamber is expelled into the discharge end of the valve. The gradual rate of opening prevents sudden surges.

When the discharge pressure exceeds the inlet pressure, Fig. 5*B*, fluid from the discharge side fills cover chamber to close the valve. The closing forces produced insure tight closure of the valve.

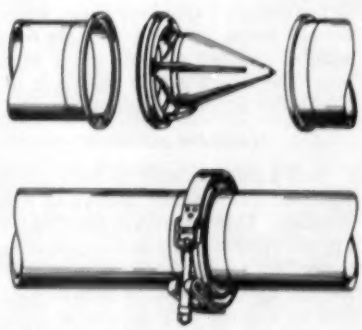
In-line valve, Fig. 6, is said to eliminate flutter due to high-velocity air flow. Suitable for temperatures from –325 to 1000 F, it has a cone-shaped valve body. The entire assembly is inserted between a coupling and flanges.

**Getting results.** While only a few of the many designs available are shown here, sufficient information has been given to outline the usual solution to vibration and noise problems in air and gas lines.

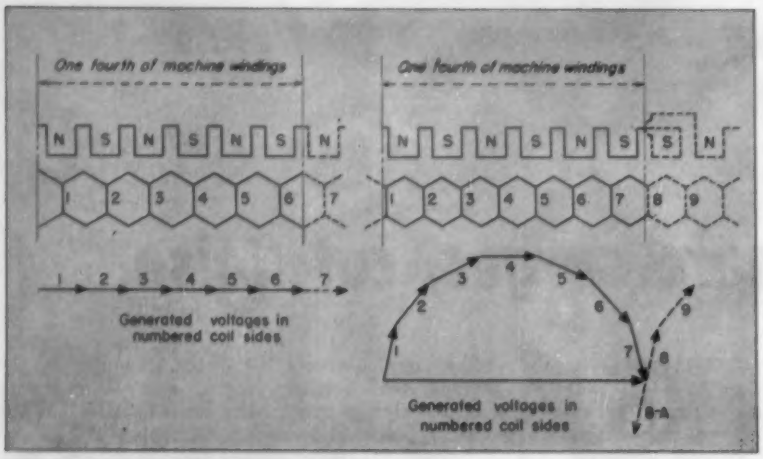
Since a valve designed to reduce vibration and noise is a specialty, it requires careful installation in exact accordance with the manufacturer's recommendations. Pressure surges and the accompanying noises follow definite physical laws. These are taken into consideration when designing a valve to suppress surges and noise. Any deviation from the manufacturer's recommendations may lead to poor results, defeating the purpose of the valve.




**5** This check valve opens, *A*, when inlet pressure exceeds the discharge pressure. It closes, *B*, when the discharge pressure exceeds the pressure in the valve inlet



**6** In-line valve has cone-shaped body, is suitable for from –325 to 1000 F


One fourth of machine windings
One fourth of machine windings
N S N S N S N
N S N S N S S N
1 2 3 4 5 6 7
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7
Generated voltages in numbered coil sides
1 2 3 4 5 6 7 8 9
Generated voltages in numbered coil sides
8-A

**USING 24 POLES:** machine runs at normal 300 rpm. There are six poles per group, and polarity of all groups is similar

**257 RPM OPERATION** is also possible. The polarity of the alternate pole groups is reversed. The voltages add vectorially

# Dual stator windings permit two synchronous speeds

By H H ROTH, *Application Engineer*
*Allis-Chalmers Mfg Company*

► A SYNCHRONOUS MOTOR or generator normally runs at only one speed. In some instances this is a disadvantage. For example, in pumped storage hydroelectric projects where head variation is high, operation at either of two different synchronous speeds may be desirable.

You can get 2-speed operation, within certain limits, by using a single rotor winding and two separate stator windings. The rotor's salient poles (dc excited) are uniformly spaced.

### FLATIRON MACHINE

Such a unit was built for the Flatiron Pumping Plant of the Bureau of Reclamation. This machine is rated 13,000 hp, 300 rpm, 60 cycle as a synchronous motor. As a generator, it is rated 8500 kw, 257 rpm, 60 cycle. It may be operated as a motor or generator at either speed.

The rotor has 24 salient poles uniformly spaced with connections brought out from rotor winding to five slip rings. This permits regrouping the rotor poles for 2-speed operation.

Stator has two separate windings that use the same slots. One winding is normal for a 24-pole 300-rpm machine; the other is normal for 28-poles, 257-rpm.

### 24-POLE OPERATION

Sketches above show how 2-speed operation is obtained. Left sketch gives the arrangement for 24-pole 300-rpm operation. For simplicity, it shows only one-fourth of the rotor and stator windings. Drawing shows stator windings for only one phase; each coil in the drawing represents a coil group.

For this arrangement the machine operates as a normal 24-pole unit having 24 salient poles and a stator winding, normal for a 24-pole machine. You can see that all coil sides are in the same relative location with respect to the rotor poles. If you consider the machine as a generator, the voltages generated in the various coil sides are equal and in phase with each other. They may be added vectorially in a straight line to obtain total generated voltage.

### 28-POLE OPERATION

Right sketch shows the connections for 28-pole 257-rpm operation. The 24 physical rotor poles are divided into four equal groups of six poles. Polarity of all poles in the second and fourth groups is reversed. This reversal is accomplished by using the leads brought out to the five slip rings, and an external double-throw switch.

Stator winding is normal for a 28-pole machine, with coil groups symmetrically spaced in the stator slots.

You can see that there are seven groups of stator coils occupying the same physical space as six field coils. Because of this difference, the voltages generated in the individual coil sides are not in phase with each other. They must be added vectorially, as shown, to obtain the total generated voltage.

Polarity of the next group of six rotor poles must be reversed. The first group of six rotor poles covers a span of seven stator coil groups. So the rotor poles of the second group have, in effect, become displaced 180 electrical degrees with respect to the stator winding.

If you did not reverse the rotor pole polarity for the second group of six poles, the voltages induced in the second group of seven stator coils would be 180 degrees out of phase with those of the first group. Total voltage generated in the two groups would then become zero.

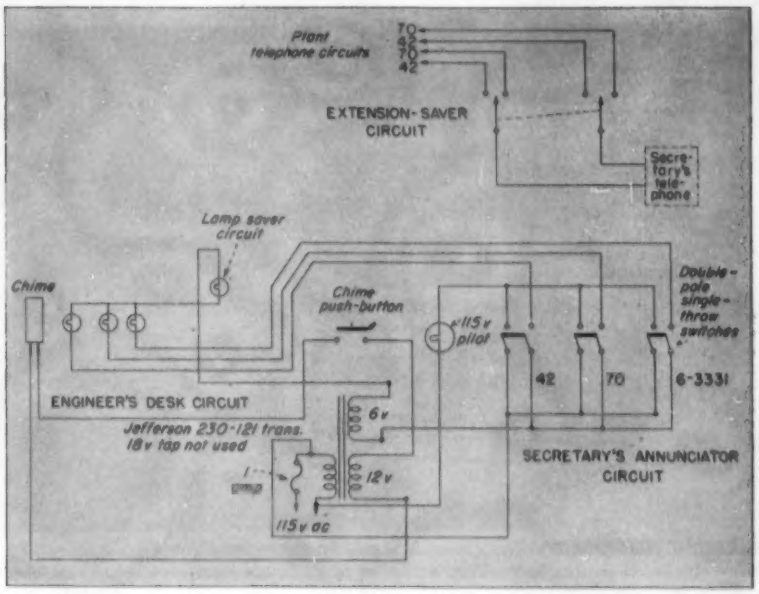
For example: Voltages generated in coil sides No. 1 and 8 are in phase with each other and equal in value. If polarity of the second group of field poles were not reversed, the voltage generated in coil side No. 8 would be displaced 180 electrical degrees as shown by vector 8*A*. It would be equal and opposite to the voltage of coil side No. 1, so the two would add vectorially to zero.

Thus, by reversing polarity of the proper pole groups and using a second stator winding, you can get operation at a second synchronous speed. Not all speed combinations are feasible.

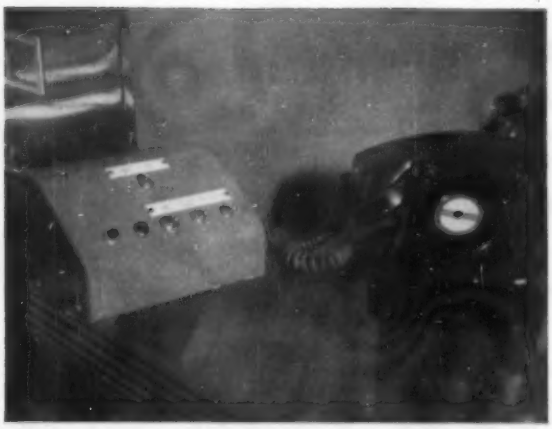
For 28-pole operation it is apparent that the magnetic circuit of the machine is not used efficiently. To produce a given kva with this arrangement, you need a machine larger than normal in physical size. The stator must carry two independent windings, one for each speed. Cost of a 2-speed motor generator is considerably higher than cost of a normal machine that has been built for a single synchronous speed.

# Phone call-box cuts office hubbub

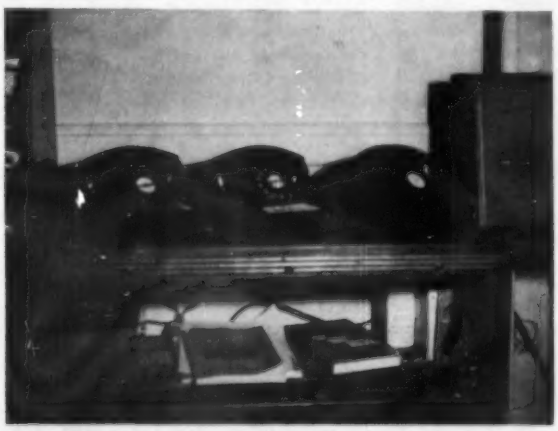
By L W FITZPATRICK, *Chief Engineer*
*Department of Corrections*
*Jefferson City, Mo.*




**SIMPLE** electrical connections for the call-box system show in this wiring diagram. Note that connections let both secretary and engineer answer calls on all three lines



**NEW** Call-box lets secretary signal which extension engineer should answer. Also takes one phone off her desk



**OLD** Unwieldy system used one instrument for each circuit, involved shouting names and numbers for all the calls

► WE USE the telephone call-box, pictured in top photo, to cut down clamor in the office. It has helped considerably. Here's why we installed it and how it works.

Each department has one phone line directly to the outside and two separate plant lines not interconnected with the outside circuit. There are the usual extensions from secretary's office to engineer's and other offices.

Before the new system was installed, the secretary had to call out which phone should be picked up for each call. This was quite noisy.

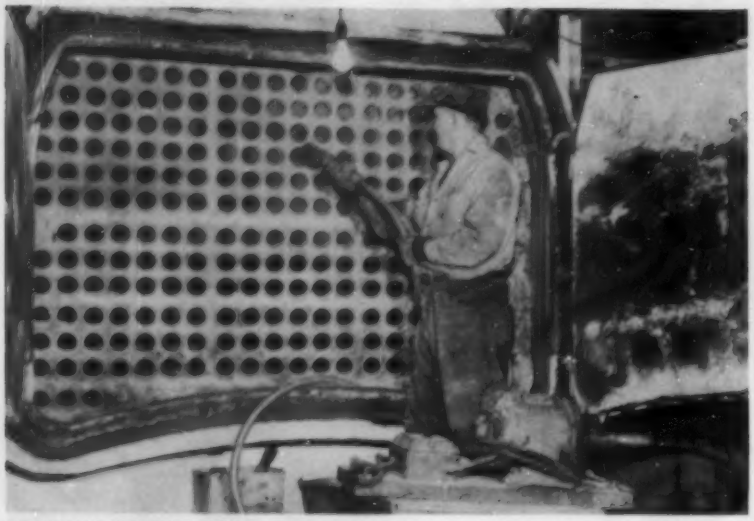
Then we installed a buzzer, but this wasn't very practical. Everyone had to remember the code system and count buzzes whenever a call came through.

Now the secretary can identify the proper phone by simply flicking a switch. She calls the right man by pushing a button that sounds a household chime near his desk.

Besides eliminating noise, the new call-box installation let us remove one instrument from the secretary's desk. A simple changeover switch on the box connects her plant phone to either of two inside circuits. When she answers an inside call, she picks up the phone, shifts switch to the proper line. Bells sound as usual at the engineer's desk.

System has low current drain. Lamps are connected in a lamp-saver circuit, have been in operation more than six months. We use bayonet- or screw-base 6-v pilot lamps.

We can parallel any number of these boxes. It's also easy to add phones by merely installing additional double-pole single-throw switches alongside those shown in sketch.



**CLEANING FIRETUBE BOILER:** Electrically driven tube cleaner with expanding brush accessory is being used here. Electric cleaner is quiet, but air type is more efficient

**WATER-DRIVEN MOTOR** with expanding cleaner. The air motor does faster job

# Clean boiler tubes mechanically

## Plant personnel can clean boilers with mechanical tube cleaners on short notice — no time-consuming preparations are necessary

By A JOHN, *Thomas C Wilson, Inc*

► GRADUAL ACCUMULATION of scale and other foreign deposits can reduce a boiler's efficiency, and continued operation with heavy scale may spell tube failure. Mechanical tube cleaners provide a handy answer to this problem. And the mechanical method has several advantages over other types of cleaning: Plant personnel can do the job, and do it effectively on all types of boiler tubes. Cost and down-time are usually less than with other methods. And it is the only cleaning method that can be used immediately without any unusual or time-consuming preparations.

Regular cleaning of boiler tubes is important, but it is often neglected. To make mechanical cleaning pay off, a set schedule is needed.

**Cleaning schedule.** Boilers in the same area may not have the same scaling problems. Rapidity of scale build-up depends on feedwater and boiler-water treatment in use. So existing conditions set cleaning schedule.

When boilers are operated continuously, it is best to clean tubes during the annual plant shutdown to avoid costly down-time. If there is no planned shutdown, fit cleaning into period of minimum load. But, in any case, keep records to make sure tubes are cleaned on time. List each boiler on a separate card, giving this information: (1) frequency of cleaning (2) last date cleaned (3) condition of tubes at last down-time (4) character of deposits encountered (5) equipment used in cleaning (6) condition of tube-cleaning equipment. This timetable, with proper follow-through, insures timely boiler cleaning, indicates out-of-the-ordinary scale formation, and serves as a reminder for ordering needed spare parts for cleaning.

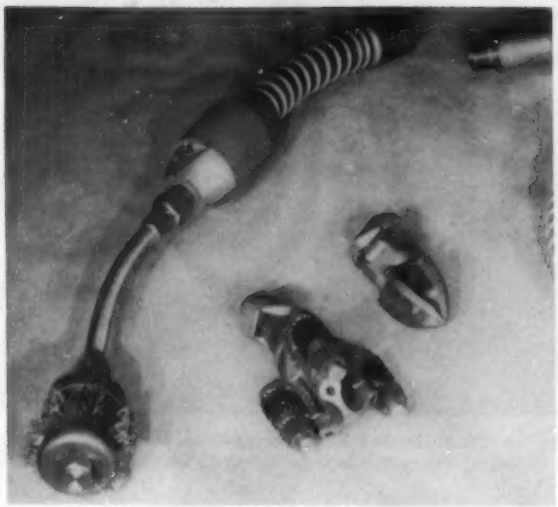
To set up initial tube-cleaning schedule, you need to know: (1) date boilers were last cleaned (2) condition of boiler tubes after a period of operation. These two items make it possible to set up a good schedule.

A visual inspection can determine the conditions of the tube only a short distance of its length, but gives a fairly accurate idea whether tube needs cleaning. Passing a mechanical cleaner through the tube gives a complete picture of tube conditions as well as approximate amount of scale present.

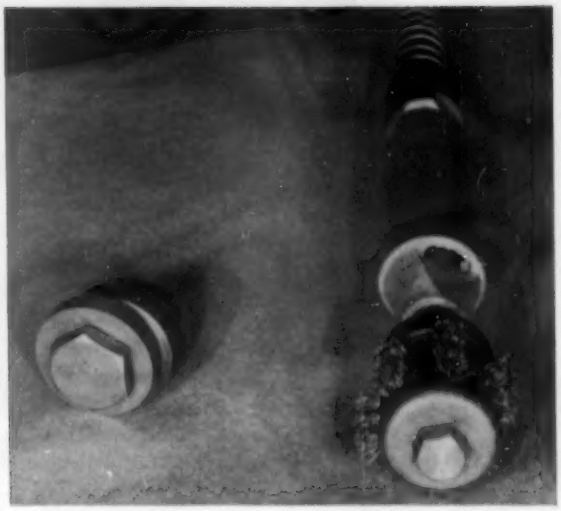
**Cleaning equipment.** There are numerous types of tube cleaners. All operate on essentially the same principle—turbining or punching. Power for the cleaning attachments is furnished by air, water, steam or electricity. Choice of the attachment depends on type and hardness of the deposit to be removed and tube construction. Manufacturer's representative can help in deciding on the proper equipment.

Least expensive accessory is the wire brush. Its use is confined to cleaning deposits that are neither hard nor gummy. Expanding-type brush is used in tubes with sharp bends—fixed-diameter brush would cause rapid wear. Expanding brush does more thorough job.

In large-diameter straight tubes,



**WATERTUBE BOILER:** air-driven cleaning equipment. Accessories are, *left to right*, brush, cutter head and drill head



**FIRETUBE BOILER:** air-driven cleaning equipment. Vibrator, *left*, knocks off scale on watersides, brush cleans firesides

brush may generally be attached directly to motor. Small-diameter straight tubes and all curved tubes call for brush attached to universal joint or flexible holder. The flexible holder is preferred, and its use considerably extends brush life.

Hard deposits that the brush cannot remove, or soft, gummy matter that clogs the bristles are removed with a cutter head. This attachment is used in straight or curved tubes. Its construction depends on the type of deposit to be removed. For very thick scale, a cutter head with limited cutting area does best "roughing out" job in short time. When scale is thin, not too hard, greater cutting area is preferred.

Tubes, scaled to the extent that a cutter head will not enter, call for a drill head mounted on a universal joint to do the job. Drill head has greater chip clearance than the cutter head and enters smaller openings. It is used only as a first pass through the tube to eliminate the worst scale. Cutter head then completes the job, leaving clean, smooth surface.

Expanding scrapers, photo at right, facing page, are useful for removing soft, gummy or wet deposits. They are most useful for cleaning flyash and soot from firetube boilers.

Expanding brushes and expanding scrapers are similar in construction. In the brush, wires are arranged in tufts or clusters, forming a cartridge. When wires become worn, cartridge is replaced. This type of brush is used more widely than any other tool for cleaning boiler tubes. The expanding scraper uses hardened-steel scraper blades instead of wire-brush refills. These blades are fixed to sides of holder. In both cases, rotation of the cleaner within the tube forces cleaning elements into close contact with tube surface by centrifugal action.

**Power.** Choice of driving power for the cleaning tools is, of course, dependent on what is at hand. With all kinds of power available, plant conditions or personal preference may decide the type. Each has its advantages and disadvantages.

Air power is fastest and most efficient, but is noisy and stirs up dust. Here the deposit is loosened and then blown out of the tube by the exhaust air of the motor. Recommended pressure is 80 to 100 psig, although cleaning is sometimes accomplished with pressure as low as 50 psig.

Water-driven cleaner keeps down dust by flushing tube as it cleans. It is quieter than air, but has less power and is, therefore, slower than air. This method also requires drainage facilities to take away the water. Operating pressure varies from 125 to 250 psig. Smaller cleaning units call for higher pressure than larger ones. For a given tube size, the higher the pressure, the greater the volume of water to be drained. Water-driven cleaners are not recommended for most firetube boilers.

Steam from a steam-powered unit sometimes softens boiler-tube deposits, but is also a potential hazard to operators. This unit is similar to air-driven ones, and requires the same pressure. Less leeway in pressure is permitted, though. Excessive condensation may occur below 80 psig, while above 100 psig, operation may become hazardous because of increased temperature.

Electrically driven flexible - shaft cleaners are quiet, but are more expensive to use than air cleaners. They are generally chosen where no other power is available. Because of their quietness, they are often found in hospitals, schools, hotels, housing projects, etc.

**Operating procedures.** Before cleaning, check all equipment thoroughly. Clean and relubricate motors if they have been stored any length of time, particularly if rust preventive has been used. Check to see that adequate spare equipment is on hand. Make sure hose is in good condition. If wear is apparent at or near coupling, hose should be repaired or replaced. Electrical equipment should be grounded.

Special precautions must be observed for steam. Make sure there is ample working room around the equipment. Never use steam if it is necessary to enter the boiler drum. Replace or repair worn or deteriorated hose. And avoid using superheated steam.

Start tube cleaner only after it is inserted in the tube. Once in the tube, pass it through at the rate of two to three feet a minute. Never allow a cutter head to stay in one place—it must be kept moving. Mark length of tube to be cleaned on hose to prevent going beyond tube with consequent damage to tube and cleaner. Keep motor running while cleaner is pulled back through tube. Shut it off completely when changing from one tube to another.

**TEXAS** Moving sidewalk carries passengers up a ramp leading from parking lot to Sam Houston Coliseum exposition hall. Opened in February, this unit has capacity of 15,000 people an hour

# Will moving sidewalks shape up as a

***Wherever many people walk from one place to another, confusion often results. But it's not hopeless. Here are two actual and one proposed installation for cutting congestion***

► OPENING the new moving sidewalk at the Houston Coliseum in February doubled the number of these units in commercial operation. This method of moving people was proposed well before 1900. But only in the last year has the tired pedestrian's dream of walking while standing come true.

One can now ride the year-old sidewalk in Jersey City, N. J. and the new one in Houston. Perhaps in a few years, people in New York City will have a conveyor system to replace the subway's present shuttle trains between Times Square and Grand Central Terminal.

In addition, people with a scientific bent can try experimental moving sidewalks in the Chicago Museum of Science and Industry, and in the Akron plant of Goodyear Tire and Rubber Co.

All these installations have cut down on congestion and speeded passenger movement. How many more the future will bring must depend on factors like public need, acceptance, financing and imaginative planning.

Here is the story on the first commercial moving sidewalks, plus a look at the system proposed for New York City.

### TEXAS

The new walk, in the Sam Houston Coliseum, Houston, Texas, uses an 82-in.-wide belt that can carry 15,000 people an hour up a 12% incline. Moving at 132 fpm, it covers the 114-ft course in 52 seconds.

This walk is driven by a 25-hp motor, through a double-reduction helical gear and roller-chain drive connected to the pulley at upper end. Handrails move at the same speed as the belt driven by roller chains from the countershaft. Unit is reversible.

Design and installation were a joint engineering project of Link Belt Co, B F Goodrich Co and Otis Elevator Co.

### NEW JERSEY

In Jersey City, N. J. a moving sidewalk is just rounding out a year's operation. This unit carries commuters at the Hudson and Manhattan Railroad Company's Erie tube station. It travels at 120 fpm, up or down, depending on the hour. For 137 of its 227-ft total length, it moves up a 10% grade. The belt is 5½ ft wide, can carry 10,800 people an hour. Drive is a 20-hp motor.

The unit was a joint project of the Stephens-Adamson Mfg Co and Goodyear Tire and Rubber Co.

### NEW YORK

An installation proposed for New York involves a low-speed moving sidewalk and high-speed belt carrying small passenger cars. Capacity is 32,000 people an hour, 9000 more than peak capacity of the existing rail system. Continuous operation and separate loading and unloading stations eliminate congestion.

This system is proposed by Passenger Belt Conveyors, Inc, a new firm set up by Stephens-Adamson and Goodyear.

According to A D Sinden, chief engineer of Stephens-Adamson, cars travel in an endless circuit, carrying passengers in both directions. On the high-speed belt, cars move at 15 mph, are spaced 70 ft apart. At the loading and unloading terminals, both moving sidewalk and cars move at 1½ mph, and cars are bumper to bumper.

Automatically-controlled doors prevent passengers from entering or leaving at any point except the terminals.

A man getting on, walks onto the moving sidewalk, then steps into the

**NEW JERSEY** Commuters at Erie Station in Jersey City have enjoyed moving sidewalk for just under a year

**NEW YORK** Shuttle trains may be replaced by a car-carrying belt system, similar to this full-size mock-up

# major factor in passenger conveying?

car moving at the same speed. At the end of the loading zone, car runs onto a live roll conveyor where rolls turn at successively higher speeds. Car accelerates to its top speed of 15 mph. Then it passes to the fast belt conveyor.

At the other end of the line, car moves over a decelerating live roll conveyor, travels through the unloading zone at 1½ mph, makes a 180-degree turn on another live roll conveyor, and enters the loading zone for the trip back.

The circuit is filled by 123 cars. Each makes 226 round trips in 24 hours, traveling 230 miles. They are electrically heated and lighted by power picked up through collectors.

The car-carrying conveyors do not call for any special features other than exceptionally true-running idlers. But the moving sidewalks need special design to insure that passengers feel safe and secure. Critical elements include diameter and spacing of idler rollers, belt thickness, maximum allowable speed, and arrangement of transition strip between belt and stationary floor.

Experiments with life-sized equipment (right photo, p 127) showed that a ¾-in.-thick rubber-and-fabric belt running on 3-in. diameter rollers set 3¼ in. apart gives a person walking on it a feeling of solidity. He is hardly conscious of the movement. At 1½ mph, any pedestrian, even on crutches, can enter and leave safely in direction belt moves.

In mechanical and electrical design, the most difficult problem is accelerating and decelerating the cars. Rate of speed change must be constant, and it must be the same whether car is empty or filled with passengers. In addition, acceleration and deceleration rates must stay in correct relation to the partial speeds of all conveyors during starting and stopping.

Here's how the special live-roll conveyor, finally adopted, works:

Each roll in an accelerating conveyor, starting at the low-speed end, is driven at a speed successively higher than the roll preceding it. But a car rests on four rolls at once. Slippage between roll rims and car bottoms is undesirable. So the four rolls under a car must turn at the same speed at any moment, yet try to turn faster to accelerate car.

To accomplish this, a friction-type slip clutch drives each roll. Clutch torque setting is such that four rolls apply enough force to accelerate a loaded car 2¾ miles per hour per second. This force is not enough to make a roll slip even if car is empty.

The system uses multiple motor drives. Each of the two high-speed belts is driven by a 300-hp motor at each end. The slow-speed, speed-change and curve conveyors require six other motors from 10 to 60 hp.

A master coordinating system controls all motors. As the conveyors are brought up to speed each motor applies about the same percentage of its full-load torque at any particular moment. Estimated starting time with all cars filled to capacity is about 40 seconds. Stopping with all cars full will take about 11 seconds.

All mechanical elements that could conceivably fail without warning will be installed in duplicate, preventing unscheduled shutdowns. Also, the electrical setup provides two power sources at each end of the circuit.

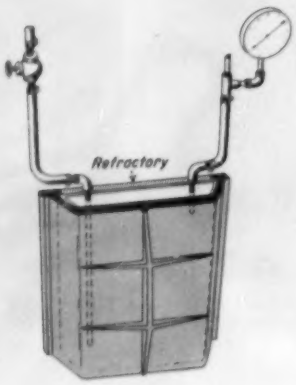
Main incoming circuit breakers automatically transfer from one power source to the other upon interruption of service. The motor sizes and locations permit entire system to operate with any one drive out of commission.

Drive motors are in two groups, one at each end of the system. A switch house at each end includes circuit breakers, motor-operated drum controllers, resistors and control center.

At the central control station near the middle of the line, the operator can start and stop all drives simultaneously. Indicating lights inform of motor overloads, tripped circuit breakers, and de-energized drives.

Colonel Sidney H Bingham, general manager of the New York City Transit Authority, estimates installed costs of high-speed conveyor equipment at less than 60% of the cost of conventional subway equipment in existing tunnels. Operation and maintenance costs are figured at 40% of similar charges for a conventional subway.

# Latest PRACTICAL IDEAS to help you do a




## Now, watercooled ashpit doors don't burn out

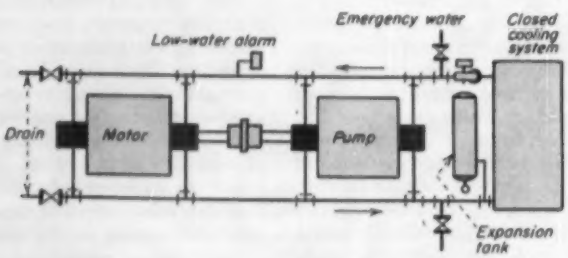
We have three 2-drum integral furnace boilers with 5400 sq ft heating surface. Coal is West Va. semi-bitumen, burned on chain-grate stokers. Ashpit doors burned and warped so badly that we had to keep replacing them, although they were covered on inside with 3 in. of refractory lining.

We made water jacket of 3/16-in. sheet iron, as in sketch shown above, to slide into door replacing refractory.

Thin refractory coating covers jacket, and city water is piped into it. Pressure gage is on outlet side and 5-psi water is maintained by cracking globe valve on inlet. Piping connections to door are made of rubber hose to allow doors to lift for removing ashes.

First door with jacket worked so well that we plan doing both doors on each boiler at next shutdown, this summer.

H Ludovici *Montreal, Que.*




## Here's my idea on Pef's September headache

Water shortage confronting the nation must have inspired Pef's idea. But editor's note is correct because bearing temperatures would increase as water passed from one bearing to another, without intermediate coolers.

Many plants use closed systems with a refrigeration-system combination for air compressors, diesel-plant installations, etc. Such closed systems can be treated chemically to prevent rust or other organic matter in water.

In Pef's case a closed system is preferable to a thermostat water control. In one plant an old, unused brick smokestack acted as a vent to carry off heat from cooling system, shown in sketch.

J M Gorrie *Euclid, Ohio*

## Flowmetering

While flowmeters are bought to meter flow under specified conditions, after installing, these conditions often differ a great deal from those originally specified.

Then you have to use entirely different multiplying factors to obtain correct flow measurement. Since an orifice meter is designed for a definite fluid, meter readings must also be corrected for pressure changes, superheat or steam quality.

Because all orifice meters are designed for steady flow, a pulsating flow may cause the meter to read high.

Electrically operated demand recording-attachments show whether flowmeter orifice plates are oversize. All plates should also accurately measure actual line losses in distribution systems, where additional meters are situated along the line route.

Recording attachments prove whether a meter is oversized. With a correctly sized orifice plate, any meter will correctly record a small steam flow. A restrictive plate on the downstream side will aid in recording low loads.

Flowmeters should always read as near full scale as possible since that is the range of greatest accuracy. Often this requires scale change for spring and winter steam demands. When checking a flowmeter installation, boiler pressure must remain constant and distribution-line pressures should be gage tested at other meter orifices.

If they vary appreciably or boiler pressure drops and swings under heavy loads, meter readings will be incorrect. A corrected multiplication factor must always be used to get true steam output at different pressures with flowmeters.

L W Fitzpatrick *Jefferson City, Mo.*

## Old tires save pavement

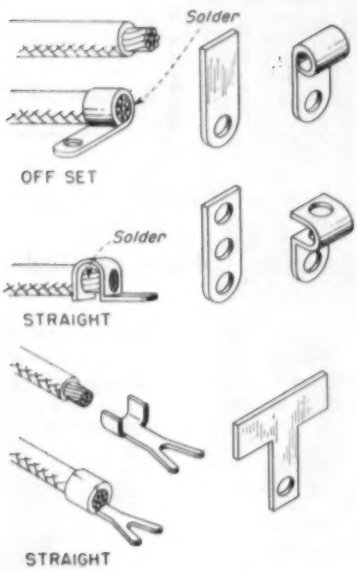
Plant engineers often have problem of getting tractors or other equipment with metal treads across a pavement without damaging it. I find that old shoes from trucks or autos, preferably the smaller auto sizes, work well.

Just place the tires in line with each tread. Then, as tractor runs over the tires, have two men in back, rolling them up in front of the slow-moving tractor. Tires are quickly handled, and I find rubber against pavement gives enough traction even to pull heavy loads.

B Clapp *Irvington, N. J.*

# better job and cut your costs

STEVE ELONKA, *Associate Editor*




## How to make safe electric-wire terminals

WHEN YOU HAVE to connect an electric wire to a switch, terminal post or screw, best and safest connection is made with terminal lug into which all wire strands are inserted and soldered. This prevents loose connections and high-resistance joint that heat under load.

Easily made types, sketches, are copper or brass if there's no other metal.

C H WILLEY *Penacook, N. H.*

## Make mandrel for pouring bearings

WHEN REPOURING a high-speed babbitt bearing don't be in a hurry at the wrong point and use a finished shaft as a pouring mandrel. This may be OK on a big, slow-speed journal which may not warp badly from heat of molten babbitt. But for small high-speed shafts, the practice is very bad.

Proven method is to turn a mandrel for pouring. This should be about two thousandths of an inch oversize for each inch of shaft diameter, to compensate for shrinkage of hot babbitt. Cold bearing will then be very close to needed running fit on true journal. Fitting will take very little labor.

Making a pouring mandrel calls for extra labor, but my experience shows it's worth the trouble.

H B MCDERMID *Long Beach, Calif.*

## Don't let this trouble fool you

"THAT NEW TANK won't make ice, Speck," yelled Mr Ward from across the street. "I've tried everything from purging the system to draining oil from the coils in trunk. I'm headed for the telegraph office now to wire the ice-machine people for an engineer, because we need the ice."

I had installed this tank the year before, and had supervised operations to acquaint the engineer with it. Well, after talking with Ward a few minutes, I promised to put the tank back in operation. "If you fix that tank I'll buy you a new Stetson hat," he promised.

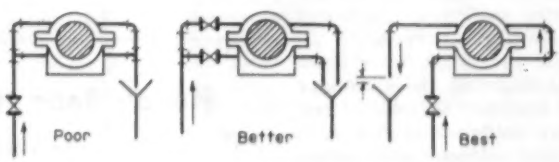
Next morning I checked pressures and ammonia and water temperatures. They were OK. Then I noticed the frost line was running to the usual place but was rather weak looking. I walked over to the oil-purge valve on tank and started to open it. Ward yelled, "I've already checked for oil in coils, Speck."

I opened the valve anyway. At first only ammonia gas came, but I had seen that happen before, so I left valve open. Soon oil began flowing in earnest.

After stopping compressor to allow pressure build-up in ammonia coils, I drew about 40 gallons of oil from tank.

Here's what happened. Purge line was very long and ammonia gas had accumulated in line. So gas had to flow out before oil. This also accounted for failure to get oil from system when opening valve. Don't let this fool *you*.

D J ("SPECK") PARMER *Quincy, Fla.*




## Ways to pipe cooling water to bearings

SKETCHES show three methods for cooling bearings I've seen in different plants. They are all workable but are not equally good. Main objection to first hookup is that one-half of bearing may not get enough water or may get no water.

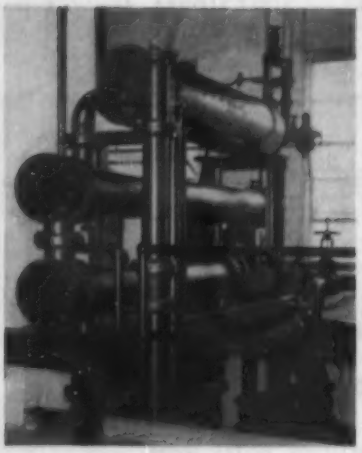
Second arrangement gives operator twice as much work because two valves must be adjusted and two outlets watched. Third sketch is best hookup, according to my experience, for following reasons: (1) You have only one valve to take care of. (2) Valve is close to outlet and can be adjusted while watching effluent. (3) End of outlet pipe, above funnel, is easily seen.

N T PEF *Boston, Mass.*

(*Continued on page* 130)

# More PRACTICAL IDEAS

Begins on page 128



## Heat exchangers level with main operating floor

WHEN WE BUILT our newest power plant, we used a different approach and installed our heat exchangers on a structural steel base right on the main operating floor.

This saves time when cleaning and eliminates splashing water on pumps and other electrical equipment on the floor below. It also permits operators to make their checks and small adjustments without carrying tools and climbing up and down steps. Steel assembly makes it easy to add equipment by extending supports upward by welding.

L W FITZPATRICK
*Jefferson City, Mo.*

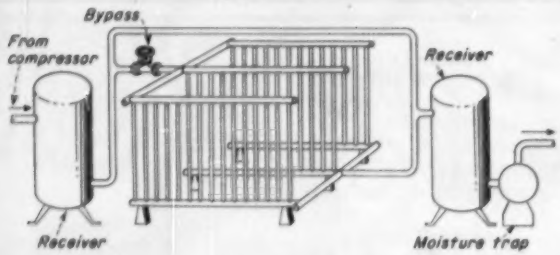
## Static electricity in shafts can be licked

THIS SELF-GENERATED CURRENT is sometimes present in shafts. Currents may be undetected as they are generated only when machine is running.

Place millivoltmeter with one terminal to a good ground and other to a carbon rod fitted with an insulated handle held on a rotating shaft. If static is being generated, voltmeter needle moves. This current would try to pass to earth via the bearings, causing pitting and sometimes bearing trouble.

Some machines are free from this problem. But these currents may be present where (1) shaft is direct-coupled to grinding or crushing machinery or (2) impeller or propeller is immersed in water. Shaft may be kept discharged by welding a slip ring to it, with brushes ground to earth.

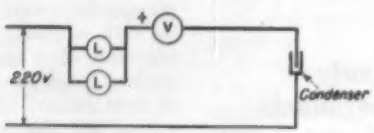
W E WARNER
*Woodford Green, Eng.*




## Our outside aftercooler is atmosphere cooled

TO COOL the volume of compressed air needed for a large railroad yard, we built an aftercooler outside. It has three rows of 1-in. vertical piping 12 ft high, welded into 6-in.-diameter horizontal top and bottom headers. With a receiver at both ends of aftercooler and a large moisture trap on discharge side, we have a maintenance-free unit, use no water.

H LUDOVICI *Montreal, Que.*




## Nail down your condenser trouble

HERE'S HOW to determine if the condenser in a circuit gives trouble when you have no condenser test kit. First, hook up two lamps, a voltmeter, and the suspected condenser, sketch. This is one time that a voltmeter can be hooked up in series.

After current is on, you learn the following:

1. Good condenser: voltmeter's hand travels close to line voltage and back to zero or very close.

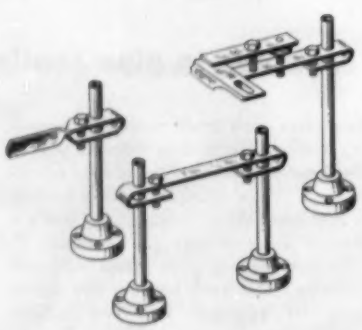
2. Leaky condenser goes close to line voltage and back to a certain voltage, but not to zero.

3. The open condenser will remain at zero.

4. Shorted condenser voltmeter's hand travels over to line voltage where it stays.

B A CROSSEN *Cranston, R. I.*

## Handy floor stands to support your work



RUGGED, easily adjustable floor stand and work supports are made from salvage material. Feature is clamping method of the U section on the end of the bar.

Bent at 180 deg, two holes are an easy fit, drilled on upright shaft. Tightening the bolt will clamp arm to upright. Use as an extra hand for various jobs that come up around the plant.

C H WILLEY *Penacook, N. H.*

(*Continued on page* 132)

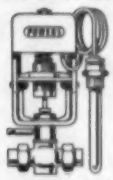
# Want control for Water Heaters, Heat Exchangers, Processes? call POWERS

**FLOWRITE**
One of Powers Premium Quality Diaphragm Control Valves. They're simple, sturdy and dependable.

Over 60 Years of Temperature and Humidity Control

(e28)

**You Will Insure Better Temperature Control IF—** you use the right type regulator and proper size control valve. Whether a simple self-operating regulator shown at left is required or the air operated controls featured here . . . you can get both types and others from Powers. For further information call or write our nearest office.



**Powers ACCRITEM Temperature Regulator and FLOWRITE Valve**—the right combination for many control problems where pressure and load conditions fluctuate widely, also for control of large size valves.

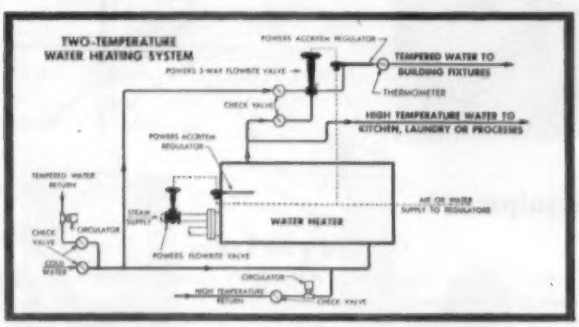
Over 50 Years Experience making this type of regulator

Control Point easily changed

Air or water operated

Ranges 50 to 250°F—150 to 350°F

**VALVES:** Available in a variety of body types and inner valves.

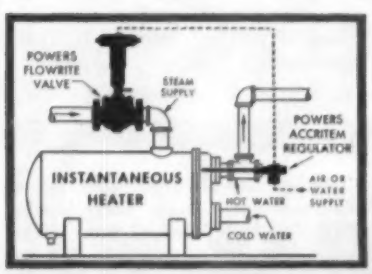


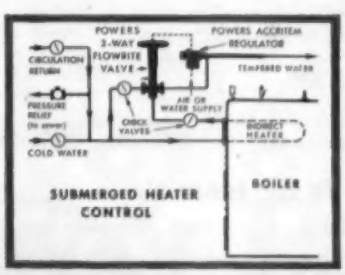

## ACCRITEM TEMPERATURE REGULATOR

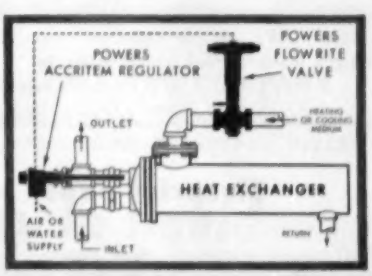
Gives Close Control and Years of Dependable Service.

- Has Adjustable Throttling Range and Calibrated Dial.
- Simple, Durable Construction assures years of trouble-free service.
- Easy to Install • Direct or Reverse Acting, reversible on the job.
- Small Size: Regulator head is 2⅞" wide, 3⅛" high, bulb is 12" long with ½" IPS Connection.

***Fully Described in Bulletin 316. Write for a copy.***




**THE POWERS REGULATOR COMPANY** | Skokie, Ill. • Offices in Chief Cities in U. S. A. Also Canada and Mexico • See your phone book

# More PRACTICAL IDEAS

Begins on page 128

## Try this magnetic chip extractor

BLOWING CHIPS from bottom of tapped or drilled hole is a bad habit. Particles shoot up, and may cause eye injury. Using compressed air is even worse. High-power permanent magnets are best, photo. Attach an extension rod to a magnet pole as shown.

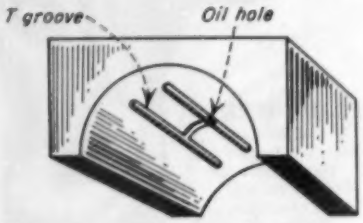
Magnetism is more highly concentrated in rod if it has enlarged head. Also, make firm metallic contact between rod end and face of magnet pole-piece. If probe is made from soft iron or steel, chips collected can be cleared easily from rod end by pulling probe from magnet. Then the particles drop away, probe is ready for another try.

C T BOWER *London, Eng.*

## Danger signs keep visitors out of equipment

USUALLY employes respect danger markings on electrical equipment. But we continually found miscellaneous odds and ends, especially behind our control cabinets. We finally selected two strongly worded stock metal signs for our electrical equipment. These large warnings instantly put a stop to using our control cabinets for plant closets. Odds and ends are easier to find now.

L W FITZPATRICK *Jefferson City, Mo.*

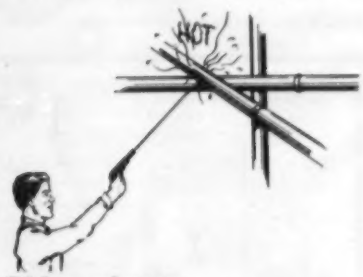



## Groove your bearings for reversing load

QUESTION about grooving bearings for reversing load, is interesting (p 143, Dec). It's never a good idea to have load direction fall near a joint in a split bearing. Better bearing life might be obtained by rotating bearing shells in housing, so load in each direction falls in an unbroken segment of shell.

As for grooving, most important point is to see that no grooves run into loaded area. Then grooves drain oil away from load-bearing pressure film. Plain axial groove, running from oil-supply hole to within a short distance of the shell end on each side, generally insures distribution of oil along bearing, for either direction of rotation. Load film won't break if loaded area for either direction of rotation is a long way from the supply joint. T groove, in sketch, may be used to reduce end-leakage loss.

P D HOBSON *State College, Pa.*




## Did you know . . .

that a toy water pistol is standard equipment for workers in the Billings refinery of Carter Oil Co? It identifies the right pipe and saves burned fingers, a squirt telling if pipe is sizzling hot. That's more sanitary than spitting on piping.

## Blueprint paper tells ac from dc

C BACHMANN SUGGESTED, Sept POWER, using a neon bulb to distinguish ac-dc. He also mentions a raw potato, glass of water and litmus paper. These all do, but often you don't have a raw potato or litmus paper handy. I got caught that way once and a man showed me another trick that's very practical.

Use ordinary blueprint paper, just as you'd use litmus paper. There is some sort of blueprint around every plant. You don't even have to tear it. Just wet a spot and touch two wires. Negative wire turns paper dark where it touches.

E A ROBERTS *Carlsbad, N. M.*

# new WIDER VISION

## for easier remote boiler water level readings

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

A new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as front of the indicator. Boiler water levels and other liquid levels can be checked from most any position.

Indicating mechanism is operated by the boiler water level itself—assuring instant, accurate readings.

Yarway Indicators are of the manometric type with automatic temperature compensation, as approved for use under the recent A.S.M.E. Boiler Code Committee ruling in Case #1155.

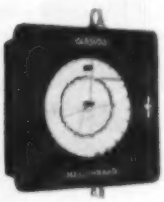
Over 10,000 are used throughout industry for boiler water and other liquid level indication . . . and for superheater pressure differential indication aboard ship.

For full information write for Bulletin WG-1824.

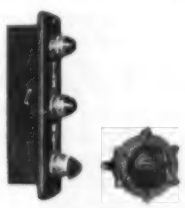
**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

### A COMPLETE YARWAY SYSTEM

Besides Remote Liquid Level Indicators, Yarway also offers Liquid Level Recorders and Remote Signal Alarms . . . making a complete system for constant, accurate liquid level check.



■ Yarway Hi-Lo-Graph Recorder provides not only water level indication, but also a 24-hour recording of water levels. See Yarway Bulletin WG-1830.



■ Yarway Remote Hi-Lo-Alarm Signals—lights or horns—can be placed at any location in plant. See Yarway Bulletin WG-1824.

YARWAY | *remote liquid level indicators*

# These PLANT PROBLEMS solved by

## The question

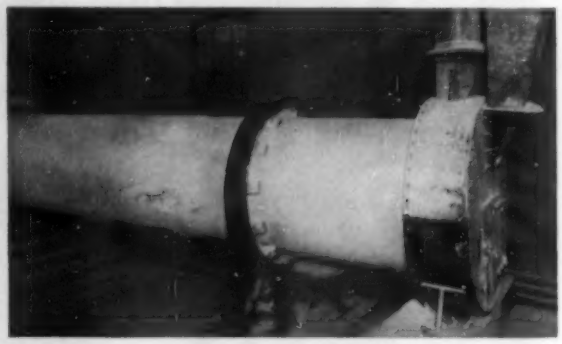
## What's best means of waste disposal?

**THE FACTS: We have to dispose of one to five tons of refuse each day, depending on production rate. Besides regular paper-mill waste containing trash, metalclad hoses, etc, there is paper in the form of trimmings and multiwall bags. This was formerly burned at a dump, but we now stockpile chips so we abandoned the practice of dump burning.**

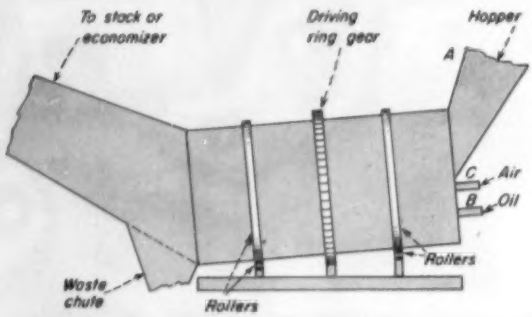
**A temporary metal incinerator was built in hexagonal form, 16 ft across corners and about 10 ft high, with a sand floor. But we found that the center of a bale of rejected bags is virtually fireproof if set on the sand bottom. Since this incinerator is to be replaced, we would like to know how to build the new one to improve air circulation through it and increase burning efficiency. Also, what is best way to unload waste?**

***—WRM, Feb Power***

## The answers



**ROTARY KILN** receives wastes through hopper at the right




## Rotary kilns burn wastes efficiently, save Btu's

HORIZONTAL ROTARY KILNS or vertical incinerators with well-designed grates and good draft will burn *WRM's* mill wastes. But bales of paper, large bundles and metalclad hose should be broken open, or otherwise reduced in size before firing. This is done by hand or by passing feed through a hogger. Also, passing combustion gas through an economizer can save over 6 million Btu per day.

The horizontal rotary kiln, photo and sketch above, is a low-cost method of burning wastes completely, with continuous ash discharge.

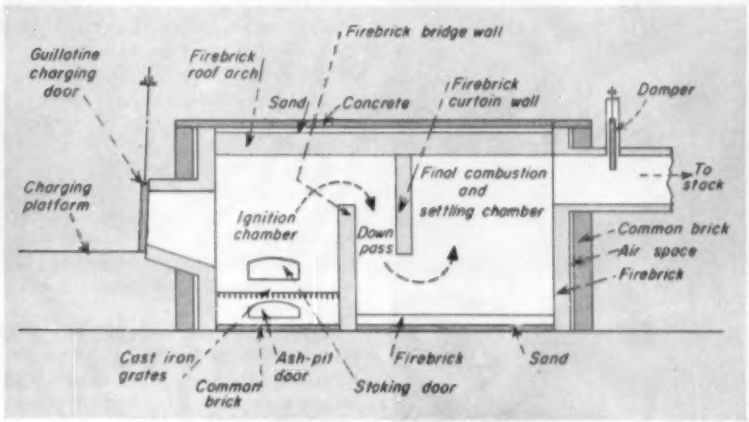
*WRM* can handle his one to five tons of refuse per day with a kiln, 36 in. diameter by 8 ft long, revolving at 6 to 10 rpm. The unit may be purchased or fabricated from light plate or a section of pipe. It needs less than a quarter of the present incinerator's space.

Disintegrated refuse feeds into the hopper at *A*, drawing above, passes through chute fitted with flash-back arrester, and discharges into upper end of the kiln. Unit receives combustion air through *B*. Connection *C* delivers oil when starting up, or when extra fuel is needed for disposal of hard-to-burn wastes like metalclad hose. Noncombustibles drop through chute while gas goes up the stack after passing through the waste-heat economizer.

M M W SHOTWELL *New York, N. Y.*

# our readers may be your problems too

HOWARD KALLEN, Assistant Editor




## Three-stage incinerator, constant loading do the best job

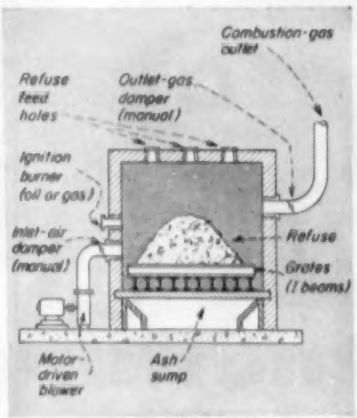
FOR BEST RESULTS, keep loading rate constant by storing refuse during low collection periods. This way, incinerator can be charged at or near capacity.

If we assume an 8-hour incineration period, unit should be rated at 1250 lb per hr for *WRM's* maximum load condition. To burn waste efficiently incinerator design should include three fundamentals of good combustion—time, temperature and turbulence. Unit shown above is divided into three stages: (1) ignition chamber, where waste is charged and fired (2) downpass, where gas accelerates to turbulent flow (3) final combustion and settling chamber, where combustion goes to completion and flyash carryover settles out.

Entire incinerator lining is firebrick to withstand 1800 F. Over-all dimensions of the unit are 21½ ft long by 7½ ft wide by 9 ft high. Grate area is 30 sq ft minimum. And final chamber is same length as ignition chamber. Stack is 42 in. ID x 50 ft, firebrick lined.

Charging platform allows pushing waste into the unit through the end door. Ash residue is pulled out through stoking and ash-cleanout doors.

M STERLING *Jackson Heights, N. Y.*




## Refractory brick must resist corrosive ash

INCINERATOR ABOVE takes refuse through the furnace top, manually or mechanically. Grates are I-beams arranged as grill work, with space between beams to allow for circulation of combustion air. Since type and quality of refuse vary over a wide range, *WRM* should install a small blower to help combustion when natural-draft air is at low level—for example, when burning damp or wet waste products.

Provide oil or gas auxiliary burner for starting up, and for difficult-to-burn refuse. Manually operated dampers allow air regulation in accordance with refuse chaarcteristics. Refractory-lined ash sump takes care of (1) ash removal by shovel or (2) mechanical removal by conveyor or other equipment.

Careful selection of refractory brick is a must, since burning paper and wood yields corrosive ash—high in potash. And the presence of metals like lead and tin, as well as broken glass, can lead to oxidation at temperatures that are destructive to some types of refractory materials.

Ash or clinkers in viscous or semi-viscous state penetrate the brick slightly, and adhere to walls and roof. Also, incinerator linings are subjected to alternate flame impingement and sudden cooling, caused by damp or wet charges.

Large, heavy wastes may need baler and conveyor system to bale refuse in easily handled bundles and deliver them to the incinerator charging ports.

H B WAYNE *Brooklyn, N. Y.*

(*Continued on page* 196)

## Design tips for troublefree incinerators

EACH DISPOSAL PROBLEM requires a separate study. No manufacturer makes a universal type for all plant wastes. Remember, fast waste removal is important. Wastes attract insects, rodents.

Average waste contains 35% moisture, 7% ash, 58% combustible. With 50-50 moisture content, *WRM* will need additional fuel for combustion. Conventional boiler-type oil burners, installed on incinerator sides, work fine. These assisting units help during cold startup.

Special alloy screens and filters should trap flue gas to reduce entrained ash particles in stack. Automatic controls keep gas, leaving furnace, below 2000 F. Pyrometer shows when combustion gas is at the desired temperature.

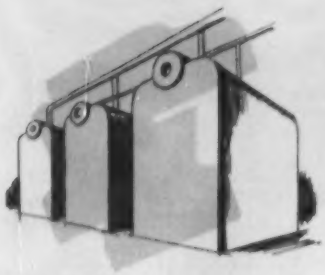
One available flyash eliminator uses a well-baffled settling chamber equipped with spray nozzles. Gas is washed and cooled, removing up to 90% of major flyash particles.

Use drying grates for wet refuse. When enough moisture evaporates, wastes are burnable. They're then routed to burning grate. Built-up ramp makes it easy to run trucks or transport carts directly to incinerator charging area. From here, a clamshell bucket with electric crane picks up wastes and delivers them to the incinerator.

L W FITZPATRICK *Jefferson City, Mo.*

# Another PLANT PROBLEM solved by readers

Begins on page 134



## The question

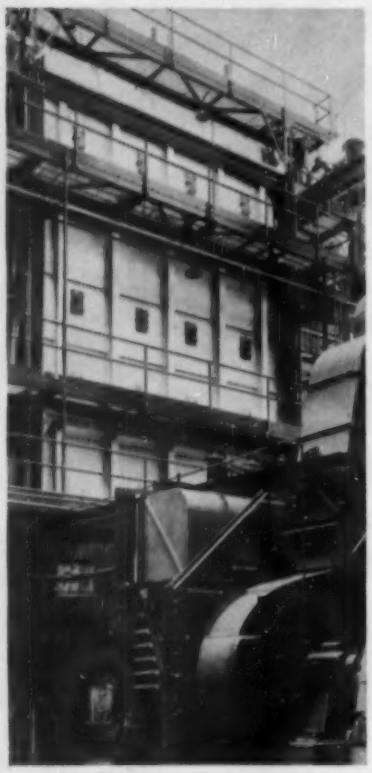
## Which schedule for boilers on line?

**THE FACTS: We use two 110-psi boilers to supply steam for heating and process. One unit stays in service three months while the other is cleaned and rested until it is scheduled to take over. Our insurance company says we can save money on premiums if we switch over to 6-month periods instead of 3-month. Naturally we would like to make the saving, but our engineer feels he knows his boilers better when he shuts down oftener. He sees no advantage in a 6-month schedule.**

**We would appreciate advice pro and con, with supporting reasons for recommendation.**

***—EC, Feb Power***

## The answers



## Check state code for inspection frequency

MOST STATE CODES and insurance-company regulations insist on annual boiler inspections for units like the one above. *EC's* engineer, after trying quarterly inspections, will most likely agree that nothing of a serious nature is wrong with any of the boilers.

If dangerous conditions are found at each quarterly inspection, boilers should be repaired under the manufacturer's guidance. But if boilers run continuously under heavy loads that make short operating periods necessary, *EC's* engineer should review operating instructions. Also, if heavy loading exists, using spare boiler can reduce load.

Boiler maintenance costs are much lower if both units are operated at the same time and inspected only once each year. These inspections should check the sheets, seams, tubes and supports. Tubes should be examined for distortion, fractures and corrosion. The search for defects should also include every piece of auxiliary equipment as well as the furnace and setting.

A J BREUGELMANS *New York, N.Y.*

## Brick in time saves nine

SOUND SCHEDULING and long-range preventive maintenance, based on good records, keep any plant running smoothly. Skill of the operating crew and unit efficiencies thus determine maintenance frequency.

Slight difference in insurance premiums, for the extra inspection, is money well spent. Frequent overhauls and checks are especially valuable when water treatment isn't too effective. We can paraphrase the old adage—a brick in time saves nine.

Maintenance overhauls provide valuable experience for a new boiler-room operator. When he learns how and why boilers work, he is a big help in time of emergency. And a well-trained crew make the right day-to-day observations and corrections that are so important for efficient boiler maintenance.

L W FITZPATRICK *Jefferson City, Mo.*

## Check special conditions

TIME A BOILER CAN STAY on the line without cleaning depends on such variable factors as scale-deposit rate, slagging, possible tube-wall burning, and likelihood of corrosion. An acceptable schedule for one plant may be impractical for another. A regular cleaning schedule is OK for a plant with steady operating conditions. But seasonal operations, as in canneries, fruit-packing sheds and heating plants, require special consideration to get best results.

O L BRAGE *Oroville, Wash.*

## Why EC should shut down boilers quarterly

I AGREE WITH *EC's* engineer. He should shut his boilers down every three months for cleaning, inspection and maintenance. It's good practice to stop troubles before they occur. And the more often you look into your equipment, the safer you'll be in the long run. In fact, most manufacturers recommend a vigorous preventive-maintenance program.

If you have standby equipment, don't save it for forced outages only. Use it to expedite a system of frequent routine-maintenance inspections.

I W ROSER *USAF School*
*T/Sgt, USAF* *Milwaukee, Wis.*



*New questions—and more on boiler scheduling, p 138*

**Problem:** Need reliable outdoor operation.

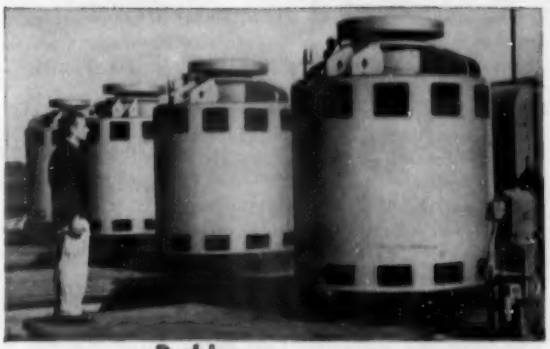
**Solution:** Use Allis-Chalmers tube-type TEFC motors rated 1500 hp, 4000 volts, 880 rpm. All electrical parts are completely enclosed, fully protected against weather.

# 3 Problems — 3 Solutions

### Eastern Utility Gets Exactly the Right Motor for Each Job from Allis-Chalmers

Public Service Electric and Gas Company chose Allis-Chalmers motors for many of the major auxiliaries in their Kearny (N. J.) Generating Plant. The reasons: reliability and economy.

Allis-Chalmers builds a type and size for every auxiliary drive in the power plant. Whether your problem is space, fly ash or an outdoor location, there's a motor in the Allis-Chalmers line to provide the continuity of service you need. Let an Allis-Chalmers representative help you select the motors for your job. A-4582

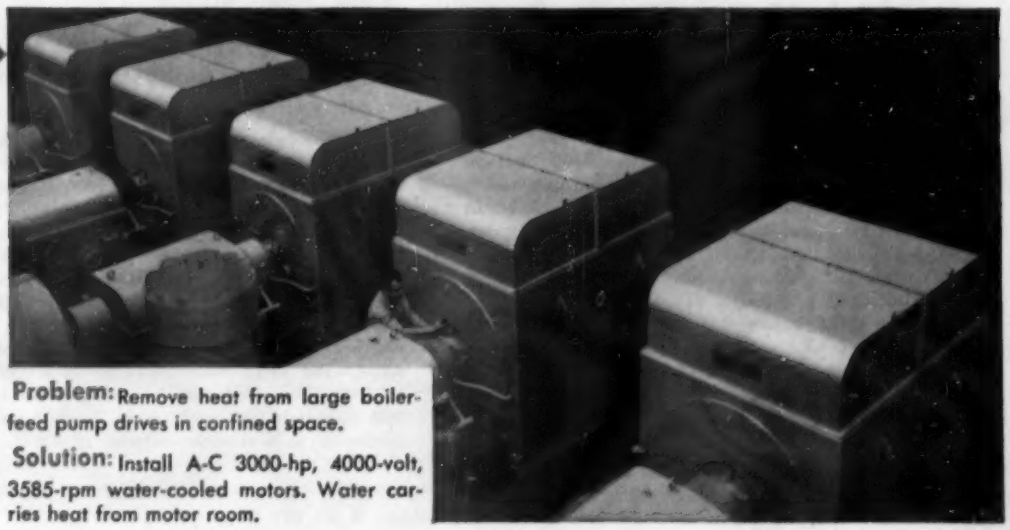


**Problem:** Keep building costs down.

**Solution:** Put pump drives outdoors, using Allis-Chalmers tube-type TEFC motors rated 350 hp, 440 volts, 400 rpm.

# ALLIS-CHALMERS

Milwaukee 1, Wisconsin



**Problem:** Remove heat from large boiler-feed pump drives in confined space.

**Solution:** Install A-C 3000-hp, 4000-volt, 3585-rpm water-cooled motors. Water carries heat from motor room.

# More PLANT PROBLEMS

Begins on page 134

## Tips on dry, wet shutdown methods

WET-METHOD BOILER LAY-UP is practical for 3-month periods. For longer periods, dry method is better. If *EC's* engineer uses wet method, he should make sure all valves—steam, feedwater and blowdown—are steam or water tight. Leaking valves can impose serious pressure, temperature and water-hammer stresses on adjacent piping, joints and boiler tubes.

When using dry method, leaking valves can corrode boiler parts by allowing water to contact metal.

Internal as well as external boiler surfaces should be kept at boiler-room temperature. To do this, close boiler damper, reducing air flow through boiler and furnace. Tight valves on steam, feedwater and blowdown lines prevent water heating in boiler—virtually eliminating sweating and temperature difference between internal and external surfaces. Sweating can cause serious corrosion if resulting moisture combines with hard-to-remove combustion products.

When laying up a boiler by the wet method, add soda ash in drum to make water alkaline; 10 lb soda ash, for each 1000 gallons of water, does a good job. After adding chemical, close manhole doors and pump boiler drum half full with clean, hot feedwater. Cold water causes sweating. Then start a light fire with boiler air vents open. When boiler starts to steam and all air is vented, close vents and complete filling drum.

A BELTON *Montreal, Canada*

## Controlling factor is feedwater

SEMIANNUAL SHUTDOWN will result in substantial dollar savings. A good many utility and industrial plants operate their boilers six months or longer—probably under much more severe conditions than *EC* does—without suffering serious damage.

Feedwater conditions set time limit on how long boiler is kept in service without cleaning and inspection. In many small plants, water treatment is virtually nonexistent. Water is treated mainly by compounds added in the boiler.

If *EC's* feedwater is the real reason for not operating boilers on a 6-month schedule, he can probably save money on his insurance premiums as well as maintenance costs by improving or replacing his present water-treating system with up-to-date equipment.

J C FISHER *N. Madison, Ind.*

## Does insurance cover only one boiler?

SPARE BOILER should be cleaned as soon as it's cool. Then allow it to dry thoroughly—inside and out. Trays of unslaked lime—25-lb lime for each 3500-lb-per-hr steam—should be placed in the drum to absorb moisture. If this is done, the insurance company is actually insuring only one boiler—accounting for the lower premium. Cost saving thus makes 6-month operation worth while.

C HARP *Stoke-on-Trent, England*

## Short lay-up period simplifies job

AN IDLE BOILER is more likely to corrode than a steaming boiler. Longer lay-up periods increase chance of corrosion. And they also require a more elaborate shutting-down procedure.

The short lay-up can be handled by flooding boilers, maintaining pH and preventing fireside condensation. Boilers can be washed and cleaned more often, scale deposits spotted before they do serious harm, and water-treating efficiency can be watched closely.

Fireside should be cleaned frequently. If *EC's* engineer is using soot blowers, their effectiveness can be checked.

Don't forget combustion equipment. Oil burners, of rotary-cup type, need frequent inspection and cleaning for topnotch performance. Schedule recommended by *EC's* engineer will yield more efficient operation, reduce chance of costly repairs and boost equipment life. Possible insurance-premium savings—due to 6-month operation—will thus be offset, making short lay-up best.

H R MATHISON *Elmont, N. Y.*

## What about slagging?

FUEL USED may decide time between shutdowns. If slag, which soot blowers can't remove, builds up on tubes and drums, then a 3-month schedule is best. But if fireside is OK, *EC* should take advantage of lower insurance rates.

B H COKER *Lompoc, Calif.*

(*Continued on page* 196)

## YOUR MAY PROBLEMS

### 1 Can we use this existing pump in our new system?

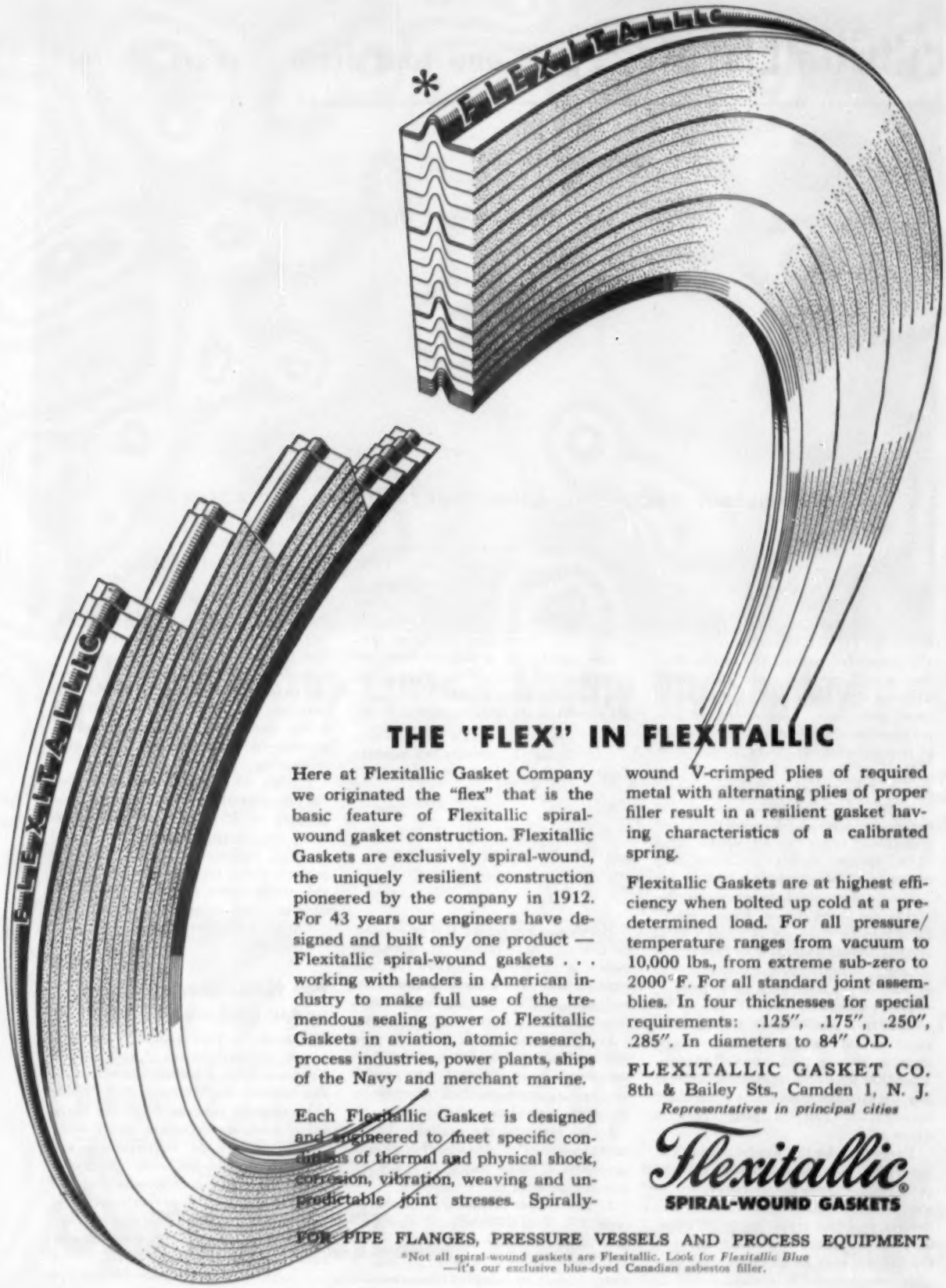
**We'd like to use an existing pump in a new system—if it'll do the job. Pump was originally bought for a capacity of 250 gpm, handling 150-F water. Discharge pressure was 280 ft with npsh of 10 ft, resulting in a total discharge head of 270 ft. Design is single stage, horizontal centrifugal. Driver is a 25-hp induction motor running at 3550 rpm.**

**Full-load flow through new system is 350 gpm, handling 150-F water. But since the piping system isn't laid out yet, we think needed total discharge head can be kept down to 240 ft or less. If we go ahead with this plan, will we overload the motor? Can we modify pump? Will original characteristic curves help us out?—*SL***

### 2 Will oxygen analysis improve our firing conditions?

**As works engineer for a medium-sized paper company, I'm responsible for purchase of power plant equipment. We're planning a new boiler installation that will burn oil as well as wood waste. Because of different $CO_2$ content in flue gas—for same amount of excess air—we believe $CO_2$ analysis is not the answer to our combustion-control problem. So we're considering continuous oxygen analysis as a guide to correct excess air. We'd like to know whether *Power* readers think we're making a wise move—and why. Since we're firing mixed fuels in a 75,000-lb-per-hr boiler delivering steam at 650 psi, 750 F, should the analyzer be hooked up as a recorder or as a recorder-controller?—*WH***

*Send your answers to Plant Problems Editor. Extra pay for photos, sketches.*




## THE "FLEX" IN FLEXITALLIC

Here at Flexitallic Gasket Company we originated the "flex" that is the basic feature of Flexitallic spiral-wound gasket construction. Flexitallic Gaskets are exclusively spiral-wound, the uniquely resilient construction pioneered by the company in 1912. For 43 years our engineers have designed and built only one product — Flexitallic spiral-wound gaskets . . . working with leaders in American industry to make full use of the tremendous sealing power of Flexitallic Gaskets in aviation, atomic research, process industries, power plants, ships of the Navy and merchant marine.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

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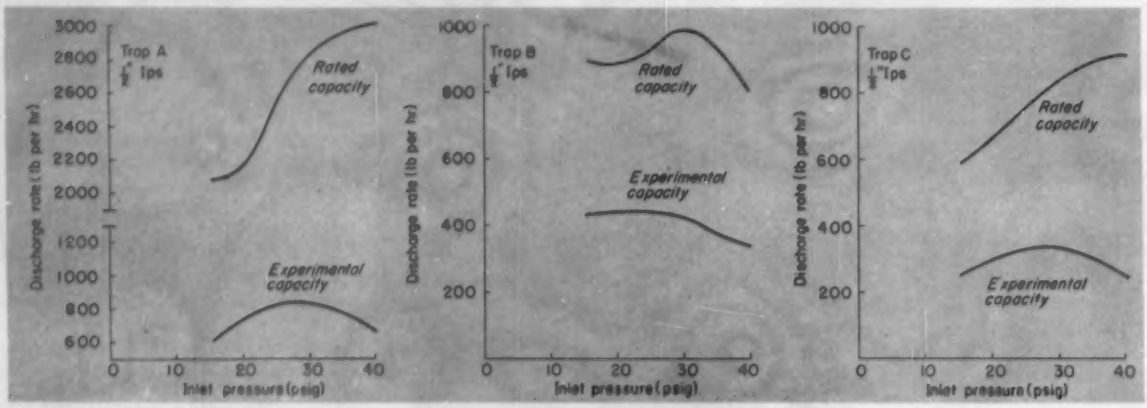
# ARGUMENTS . . . *pros and cons from readers' letters*

ALTHEA THORNTON, *Assistant Editor*




## Are actual steam-trap capacities less than guaranteed?

I BELIEVE that in general the discharge capacities claimed by steam-trap manufacturers are way above possible theoretical maximums.

I studied steam-trap performance to determine (1) actual discharge capacity (2) thermal efficiency. The results show that actual capacities are only 28 to 43% of the guaranteed capacities at rated conditions. Limitations of temperature instrumentation made results of thermal efficiency tests inconclusive.

None of the traps I tested even approached the manufacturer's guaranteed capacity. For example, look at the curves for trap *A*. Experimental and guaranteed capacities are shown for a ½-in. upright bucket-type steam trap of semisteel body, stainless trim.

Note differences between magnitude and slopes of the curves. Experimentally, maximum capacity is about 840 lb condensate per hour, at inlet pressure of 30 psig. Manufacturer rated this trap at 3020 lb per hour max, at 40 psig.

The guaranteed capacity curve increases to a maximum at 40 psig. The experimental curve increases to a maximum at 30 psig, then drops off sharply. The other experimental curves are similar. Maximum capacity is somewhere between 25 and 30 psig; then it drops off.

There may be two explanations: (1) Steam-flow rate at this point may be too great for experimental condenser to work. Then not all the steam is condensed and the traps begin to close, keeping live steam from escaping. (2) Condensate may be at the highest possible temperature to remain liquid at this pressure. Actually, condensate is liquid at the steam temperature. Then, as the trap discharges, liquid begins to flash. When condensate begins its acceleration from the trap, backpressures are set up, decreasing discharge rate.

One conclusion is definite from my investigations; none of the traps tested met manufacturers' rated claims. Here are results of six tests in tabular form:

| *Trap* | *Pipe size in.* | *Rated capacity lb per hr* | *Experimental capacity lb per hr* |
|---|---|---|---|
| A | ½ | 3020 | 840 |
| | ¾ | 5760 | 1690 |
| B | ½ | 1050 | 425 |
| | ¾ | 1925 | 770 |
| C | ½ | 940 | 330 |
| | ¾ | 1560 | 580 |

Here's another point: It is impossible to compare the results of discharge tests of any two traps. Nor can you compare traps on the basis of manufacturers' ratings. No manufacturer shows how his ratings were established. But I do not suggest they deliberately publish misleading information. Many errors result from different test procedures, rating methods, lack of common standards, calculation methods, etc.

I also reviewed the available literature to get data on theoretical discharge capacities of steam traps. Here are my conclusions from this work:

1. You cannot predict trap discharge capacities from knowledge of the pressure drop across the trap alone.

2. The amount of leakage through a steam trap is an inherent characteristic of each of the specific makes of trap.

3. To evaluate discharge capacity properly, consider these variables: (a) pressure differential across trap (b) temperature of discharged condensate (c) flow conditions in the discharge line (d) construction characteristics.

4. Most manufacturers' ratings are not based on condensate at steam temperature, but on hot water at 20 to 80 F below steam temperature. Therefore, guaranteed capacities are somewhat misleading.

I think we need a standard method for rating and testing steam traps, to be adopted by ASME or ASHVE. Otherwise, steam-trap manufacturers should form an institute or association to cooperate with a selected agency and provide the industry with universal means of evaluating steam-trap performance.

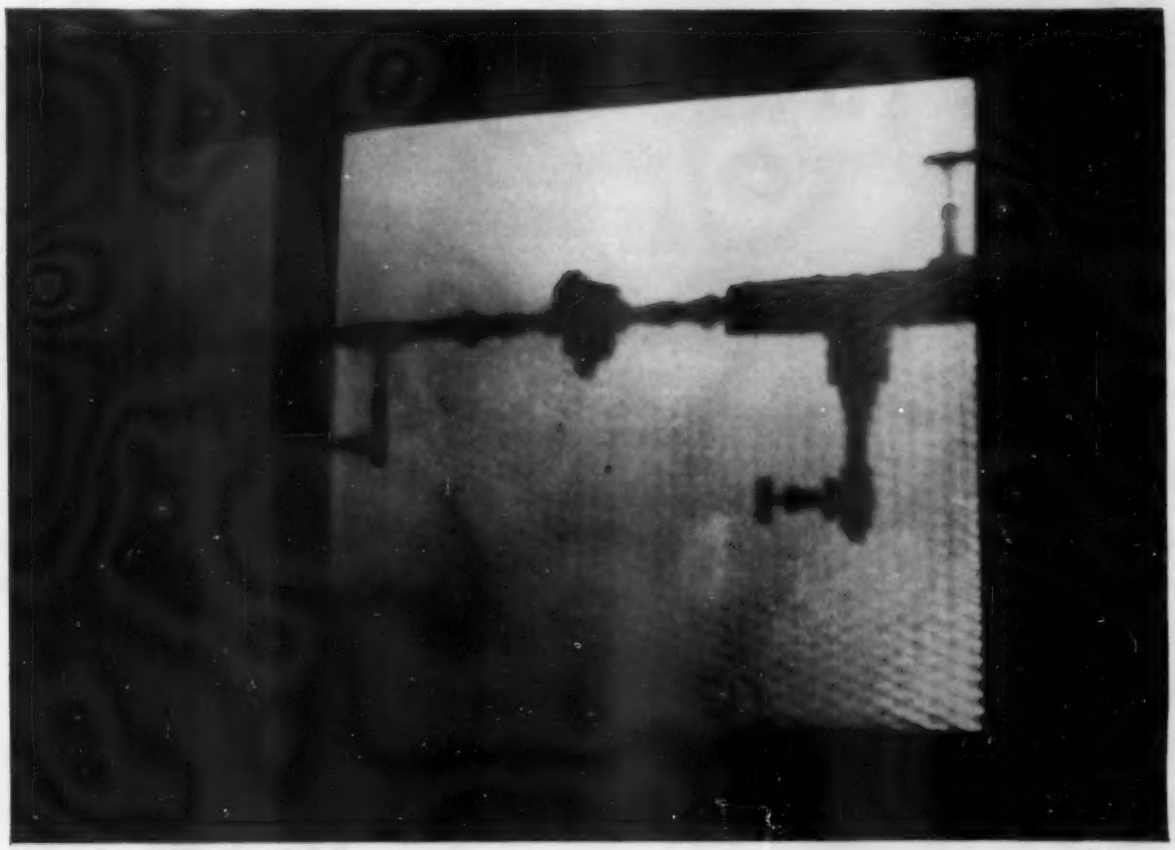
ARNOLD BOGART, *Chief Engineer*
*Bogart Co, Los Angeles, Calif.*

## Put feedwater pressure under globe-valve seat

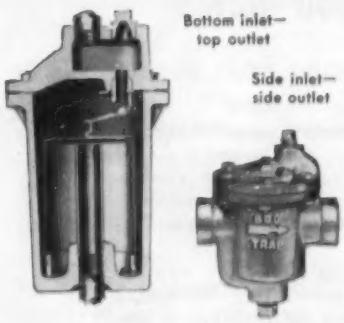
REFERRING to your article "Now we'll inspect external fittings of your boiler," February 1955. I believe you will agree that caption No. 7 should read "Globe valve must be between drum and check valve, *feedwater* pressure under seat."

This is a code requirement, and should always be followed. The reason is that valve disk may become detached from stem. With a properly installed valve—that is, with feedwater pressure under the seat—the valve could continue to feed water to the boiler. But if

(*Continued on page* 200)



# A Steam Trap Casts a Mighty Big Shadow

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**Faster Heat-up.** Oven at pharmaceutical plant heats up 40 minutes sooner.

**More Production.** 30% more output from cooking kettles at National Cranberry Co., South Hanson, Mass.

**Less Fuel.** Coal consumption reduced 400 tons annually at A. J. Tower Company, Boston, Mass.

**Less Maintenance.** 25% less trap maintenance at Hooker Electrochemical Company, Tacoma, Wash.

BIG effects from little traps! And, the effects are multiplied by the number of traps in your plant until they grow to be a major influence upon operating efficiency. Your nearby Armstrong Representative can help you get maximum output from steam heated equipment at minimum cost. Call him, or write:

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The 44-page Steam Trap Book gives more examples of how good trapping helps users, tells how to get it . . . selection, installation, maintenance. Free on request — write or call today.

Armstrong traps also cataloged in Sweets and Chemical Engineering Catalog.

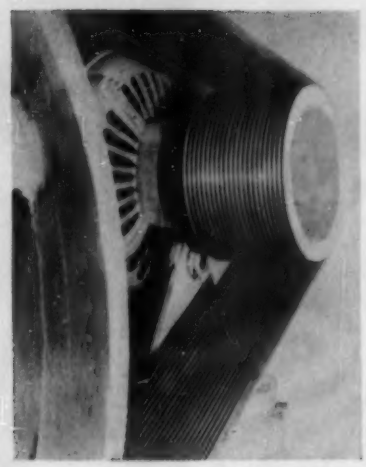
855

1 Align the sheave with pulley by placing straight edge or cord along edges, as here. The two shafts must be parallel

2 Move sheave close enough to pulley so ribs are not harmed while sliding on belt, then tighten belt for right tension

3 Correct tension for this type of belt is somewhat tighter than for usual multiple-V design. If loose, belt squeals

4 Protect with guard, then run-in belt for about two weeks before checking again. It will probably need tightening



# HOW TO

## install new ribbed belts

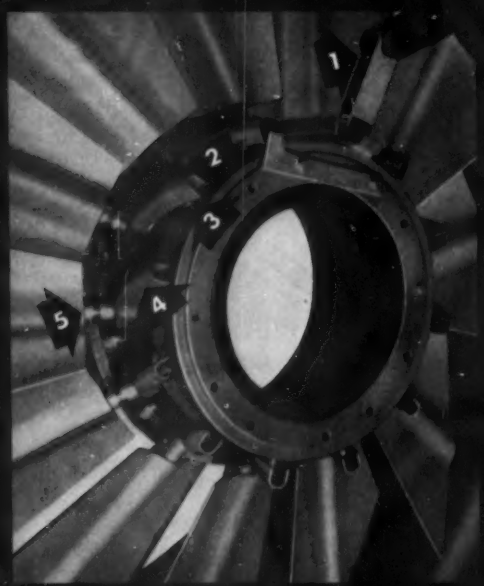
► NEW power-transmission belt (above) is a single type, with molded V-shaped ribs that fit into the sheave grooves. Pictures, left, point up some angles to pay special attention to when installing these belts.

After aligning the sheave with the pulley, always move sheave close enough to pulley before installing belt to prevent harm to its ribs from sliding over the pulley or sheave ribs. Run-in the belt for about two weeks and check again for tension. Chances are it will need tightening. Loose belt squeals.

*Courtesy: Rubber Division of Raybestos-Manhattan, Inc*

# Fact:

## STURDY WESTINGHOUSE-STURTEVANT INLET SPIN CONTROL SAVES FAN POWER WITH CONSTANT-SPEED MOTORS



Operating mechanism is shielded from the gas stream but is readily accessible from the outside for inspection and maintenance.

5-POINT POSITIVE OPERATION. As link and lever (1) moves the operating ring (2) hardened steel spherical pins (3) turn crank arms (4) welded to the tubular vane cores (5). Each vane turns on a heavy steel rod anchored between the center mechanism and outer steel support. No lubrication is required.

### SPIN CONTROL CUTS OPERATING COST

The combination of Westinghouse Inlet Spin Control and the simple squirrel cage constant speed motor is less costly to install and provides greater overall power savings than other types of mechanical draft control.

### SMOOTH, SIMPLE ACTION

Inlet Spin Control has no gears—no backlash. Provides instantaneous control of draft. Vanes move rapidly in the open range, yet fine adjustment is possible in the near-closed position. Extremes of heat and cold do not affect its operation in any way.

### MOST EFFICIENT, MOST ECONOMICAL

In any comparison of both forced and induced draft fans and their control devices, you will find Inlet Spin Control is both the most efficient and economical choice.

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*Please send more facts on Inlet Spin Control.*

NAME AND TITLE.....

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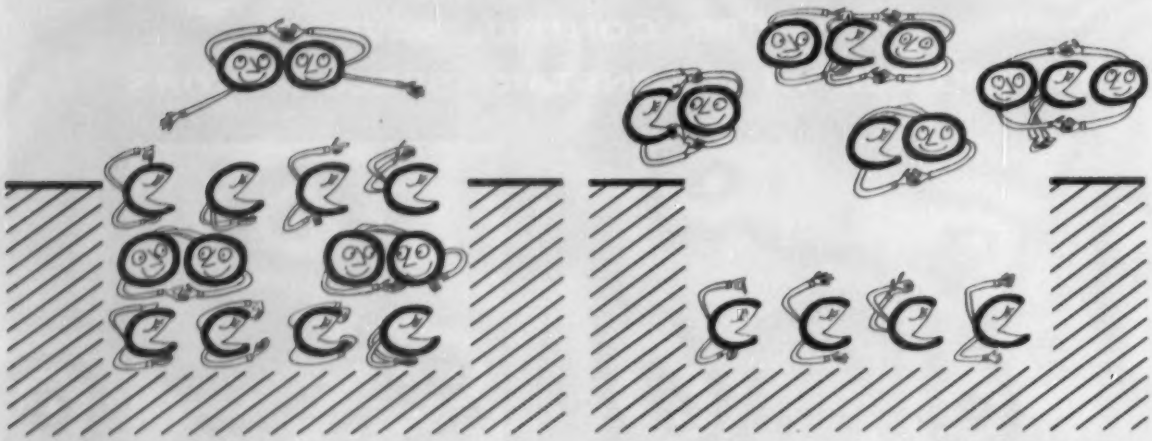
# BASICS . . . *bringing engineering theory down to earth*

TOD WALDRON, *Assistant Editor*



**OXYGEN** molecules penetrate behind outer carbon-atom layer

**OUTER CARBON** breaks off solid piece; atoms, oxygen combine

# How fuels burn-5

► To understand practical combustion problems, as previous Basics have shown us, we must take a look at each of the forms in which carbon and hydrogen appear in commercial fuels and the steps they pass through in burning. To make this a little easier, consider all complex fuels as combinations of three simple or elementary fuels: (1) gaseous hydrocarbons (2) solid carbon and (3) a mixture of carbon monoxide and hydrogen. Each of these general groups contains a variety of fuel substances. They differ in minor respects (charcoal and coke in the solid-carbon class, for example), but each group displays a generally similar pattern of combustion.

Some commercial fuels are simple mixtures of these elementary types. Thus, coal gas is essentially a mixture of gaseous hydrocarbons and carbon monoxide plus hydrogen. With other familiar fuels, our elementary fuels come into existence during the burning process; fuel oil volatilizes into gaseous hydrocarbons before actual combustion. Some cracking may occur, yielding solid carbon and hydrogen.

Coal is another fuel that decomposes into elementary fuels before actual combustion starts. When first exposed to the fire's heat, gaseous hydrocarbons, carbon monoxide and hydrogen are distilled off, leaving solid carbon behind. Hence, to know what actually happens when coal burns we must know the individual burning processes of all three elementary fuels.

**How carbon burns.** We've dealt with some of the tougher aspects of how fuels burn, having already seen how combustion works with gaseous hydrocarbons. Now we come to one process that has puzzled experts for many years—burning carbon. But careful experiments seem to check present theory on this.

There are two entirely different processes of carbon combustion. The first takes place at temperatures up to about 2200 F. Here oxygen molecules penetrate behind the outer layer of carbon atoms and become loosely linked to them. When all the free space behind this outer layer is occupied with oxygen, the layer breaks away from the solid carbon. Oxygen and carbon then combine to form equal amounts of carbon dioxide and carbon monoxide (see illustrations at top).

The second process starts at a temperature of about 2700 F. This consists of carbon atoms being attacked by oxygen molecules without any prior penetration of oxygen behind the outer carbon layer. The result of this type of combustion is to give twice as much carbon monoxide as carbon dioxide.

Going back to the first process, this type of burning gets faster and faster up to about 2000 F and then decreases in speed till, at about 2400 F, it's practically at a standstill. Falling off of this process is due to decreasing solubility of oxygen in carbon with increasing temperature.

Now, taking the two together, we see that there is no active form of combustion for carbon between about 2400 and 2700 F. So carbon burns very badly between these temperatures. This may give us some insight into why oil flames are often luminous—glowing carbon particles that burn very slowly in spite of exposure to high temperatures from 2400 to 2700 F.

**Burning $H_2$ and CO.** Hydrogen and carbon monoxide are grouped together as an elementary fuel because they commonly occur together. Ordinarily, combustion seems to happen according to these simple reaction equations:

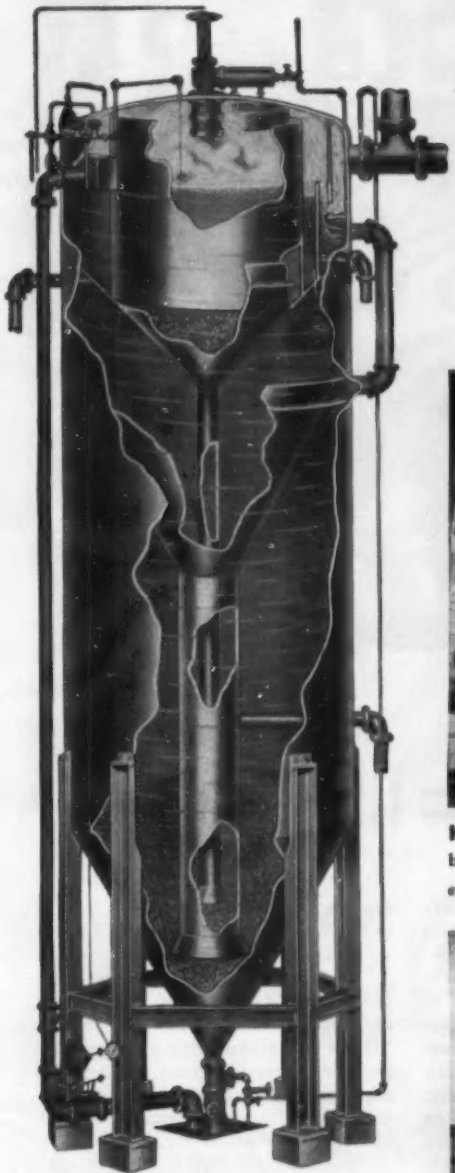
$$2H_2 + O_2 = 2H_2O$$
$$2CO + O_2 = 2CO_2$$

Hydrogen burns more than 2.5 times as fast as carbon monoxide when they burn together with excess oxygen. Presence of water or hydrogen apparently speeds up the combustion of carbon monoxide.

At one time, carbon monoxide was believed to be slower burning than the hydrocarbons. Tests show, however, that the opposite is true. Test results show that carbon monoxide burns much more rapidly than the hydrocarbons.

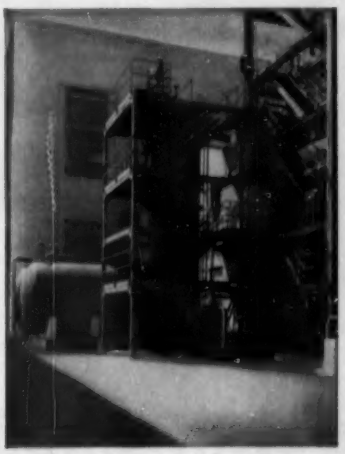
# In Hot Process Softening, too

# BELCO Builds a Complete Line-

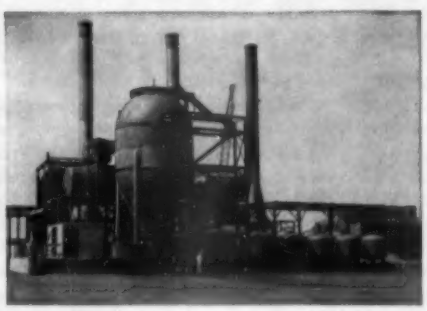


Belco-designed equipment provides high operating efficiency at low operating costs. Many of the country's largest industries rely on Belco for their water conditioning equipment. For example, Belco has built the largest fully automatic demineralization plant in the world and is currently furnishing one of the largest hot lime zeolite installations. A consultation with Belco could lead to lower operating costs for you, too. Write or call for technical assistance at any time.

**HOT LIME SODA** — Installation in boiler house at large eastern oil refinery. Has capacity of 200,000 lbs/hr.



**HOT LIME SODA** — Installation in large southwestern utility. One of three units with 90,000 lbs/hr total capacity.



**HOT LIME BELCOLITE** — Installation at large southern chemical company. Capacity 600,000 lbs/hr. This plant embodies "thoroughfare" operation of separate deaerator and hot process tank. The large hot process tank was designed, built and erected by Belco under its contract with customer.

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**BELCO DESIGNS, ENGINEERS & FABRICATES WATER PROCESSING EQUIPMENT**

"Bilgewater on tall funnels," roared Marmy, grabbing a bottle of the beer.

# Tall chimney + fan = no draft?

► WHEN I HEARD last December that Marmy's old shipmate Leonardo Villarta, in the Philippines, sent him a case of that internationally famous San Miguel beer for Christmas (from halfway round the world), Associate Editor Ben Skrotzki and I scooted right over.

The dingy office above O'Houlihan's Machine Shop & Engine Works was plenty noisy when we reached it by way of the creaky stairs. The crafty old consulting engineer, Marmaduke Surfaceblow, was anchored in his swivel chair, but paid no attention to the commotion. He was busy as usual, doing a lot of skull drudgery on a stack of papers. The case of beer was in sight, all right, and Marmy and his seafaring cronies seemed to have the situation well in hand.

We found ourselves in the midst of a red hot, but highly scientific, argument. Seemed to be about beer—about the buoyancy (because of specific gravity) a person would gain or lose, should he fall overboard if he were full of beer (by volume) as compared to Sandpaper Gin—or something. Anyway, the ship's funnel got into the story at this point—for no logical reason that I could see.

Then the subject suddenly got back to beer—the time a ship ran out of makeup water in the Yellow Sea (evaporator salted up) so firemen were given what to them must have been the heartbreaking task of pouring bottle after bottle of beer into the hotwell to keep the water (I mean beer) from getting out of sight in the boiler gage glasses.

The deck crew was busy hoisting cases of San Miguel beer out of cargo hold No. 2 and lowering them down the engine-room hatch. And firemen kept opening bottles and pouring them into the hotwell—and, by golly, they just did keep up with the water in the gage glasses, until finally the ship dropped anchor in Hong Kong, 340 cases or 12 hours later. Wow!

This was too much for me, but the ship's funnel got back into the story at this point—again for no logical reason except that one character, who was wearing a beat-up high-pressure cap of a merchant marine officer, wanted to talk about the ship's funnel. I guess we all know people like that.

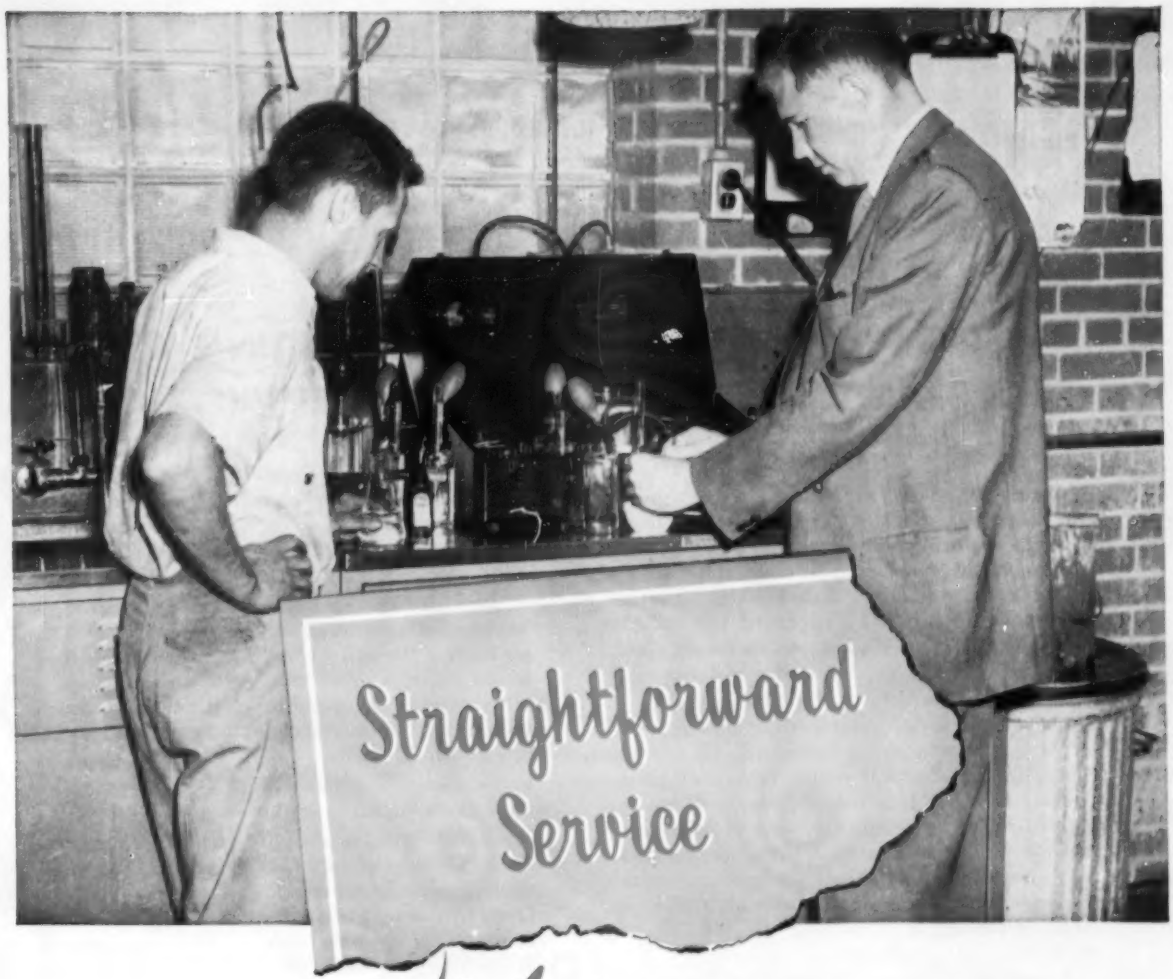
"Now take the old Morgan Line freighter *SS Cyclops* that I started on as coal passer in 1912," he rasped. "There was a ship with a funnel that kept her fireman signing the articles, trip after trip. And as I always said, if your funnel is high enough, you don't have to worry about draft."

"BILGEWATER on tall funnels," roared Marmy, throwing down his pencil in disgust. "I'll tell you waterlogged engineers about a boiler that had a tall stack *and* a fan. But she *still* wouldn't steam because the air wouldn't move."

That stopped the works. Marmy leaned back in his swivel chair and plopped his feet up on his tired old desk. He yanked the cap from another bottle of San Miguel (as did everyone else), worked up a 16-inch vacuum and, after bunkering his bottoms, blasted away.

"Back in 1932, when the depression

(*Continued on page* 190)

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A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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# JENKINS PRACTICAL PIPING LAYOUTS 75

*How to plan*

## PIPING CONNECTIONS FOR SPACE HEATING WITH REFRIGERATION CONDENSER HOT WATER DISCHARGE

**Where continuous refrigeration** is required, the heat absorbed by the water circulating through the condensers during the refrigeration cycle may be transferred to circulating air and used for space heating. This hookup illustrates a system that is widely approved for utilizing waste heat in frozen food plants, ice cream plants, supermarkets, and refrigerated warehouses.

**A cooling tower** for water conservation is included in the usual water cooling system for refrigeration condensers, as indicated. All or a portion of the water which usually flows through the cooling tower system may be diverted and circulated instead through a water coil in the summer air conditioning unit. A three way modulating valve actuated by a room thermostat, controls the water passing through the two parallel circuits, dividing it according to the heating requirements.

**Excess heat,** when all the heat is not required, is removed by regulating the amount of the water circulated through the parallel path of the cooling tower. Additional heat may be provided, when needed, from any other customary source.

**The cooling tower** circuit provides for water storage in a tank inside the building to avoid freeze-ups. The water circuits shown can be full weight red brass pipe, copper tubing, or black iron pipe.

**This combination** of refrigeration and heating is an adaptation of the heat pump cycle and will provide both refrigeration and heat for minimum operating costs.

**Jenkins Fig. 368 Bronze Gate Valves** are recommended for shut-off service in this system. The position of the rising spindle indicates at a glance if the valve is open or closed. Outside threads allow easy cleaning and lubrication. Solid wedge affords maximum resistance to pressure strains.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17. Sold through plumbing-heating and industrial distributors.

Fig. 368
BRONZE
GATE VALVE
Solid Wedge — O.S.&Y.
Rising Spindle
125 lbs. Steam
200 lbs. O.W.G.

**SEND FOR THIS FOLDER.** It illustrates and describes the complete line of Jenkins Bronze Gate Valves, which includes 40 different patterns for various service conditions. Contains handy chart for quick reference. Fill out and mail coupon today.

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# PIPING CONNECTIONS FOR SPACE HEATING WITH REFRIGERATION CONDENSER HOT WATER DISCHARGE

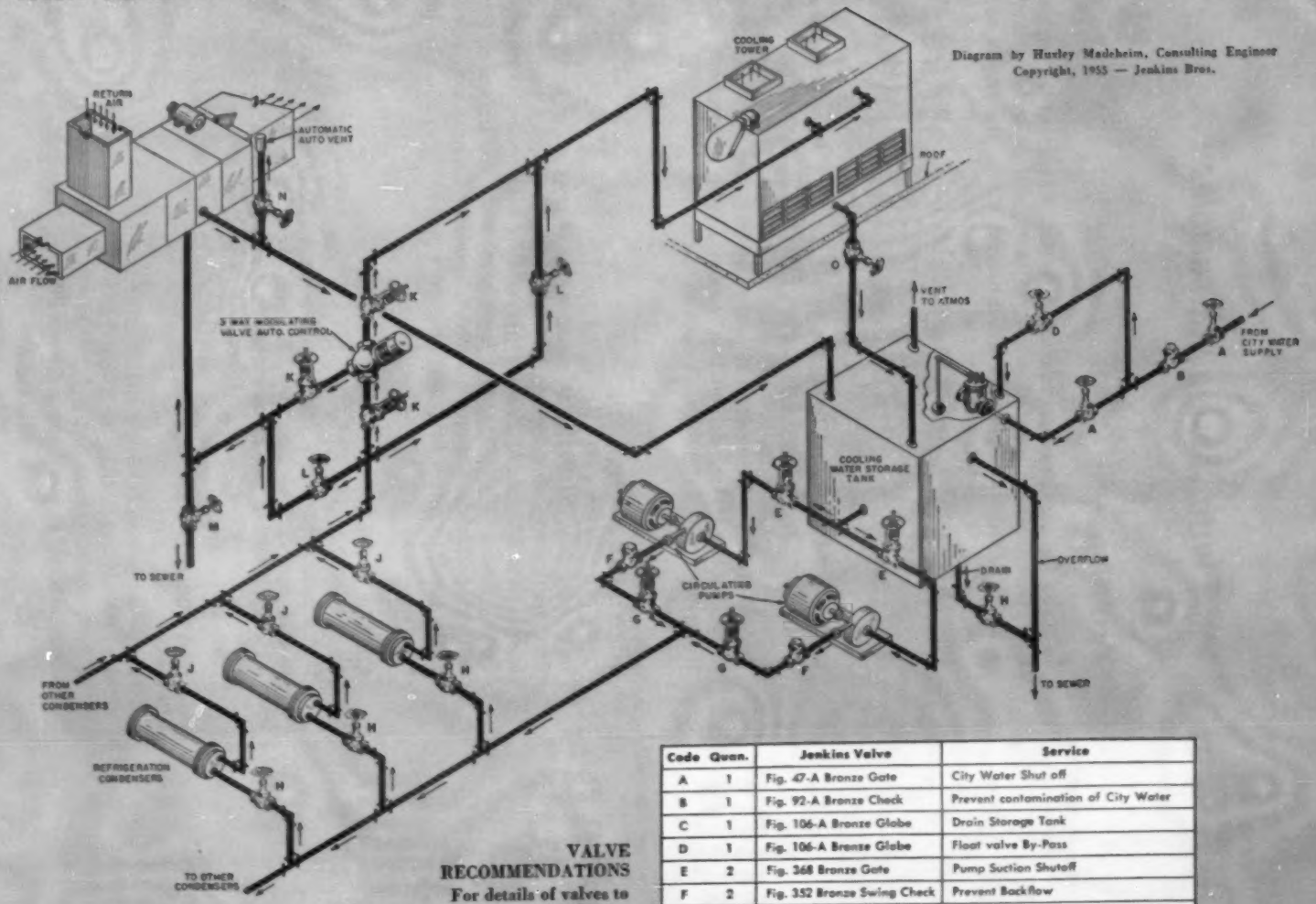



Diagram by Huxley Madeheim, Consulting Engineer
Copyright, 1955 — Jenkins Bros.

| Code | Quan. | Jenkins Valve | Service |
|---|---|---|---|
| A | 1 | Fig. 47-A Bronze Gate | City Water Shut off |
| B | 1 | Fig. 92-A Bronze Check | Prevent contamination of City Water |
| C | 1 | Fig. 106-A Bronze Globe | Drain Storage Tank |
| D | 1 | Fig. 106-A Bronze Globe | Float valve By-Pass |
| E | 2 | Fig. 368 Bronze Gate | Pump Suction Shutoff |
| F | 2 | Fig. 352 Bronze Swing Check | Prevent Backflow |
| G | 2 | Fig. 368 Bronze Gate | Pump Discharge Shutoff |
| H | 3 | Fig. 106-A Bronze Globe | Condenser Water Control |
| J | 3 | Fig. 370 Bronze Gate | Condenser Water Shutoff |
| K | 3 | Fig. 368 Bronze Gate | Modulating Valve Shutoff |
| L | 2 | Fig. 106-A Bronze Globe | Modulating Valve Bypass |
| M | 1 | Fig. 106-A Bronze Globe | Drain Heating Coil |
| N | 1 | Fig. 106-A Bronze Globe | Vent Control |
| O | 1 | Fig. 106-A Bronze Globe | Cooling Tower Water Discharge Shutoff |

**VALVE RECOMMENDATIONS**

**For details of valves to suit varying conditions see Jenkins Catalog.**

*Illustrating the proved 3-point formula for trouble-free, time defying hookups*

**A Use the right type valve for the service**

**B Place valves correctly in the line**

**C Choose Jenkins for lifetime economy**

JENKINS VALVES
LOOK FOR THE JENKINS DIAMOND
SINCE 1864
TRADE JENKINS MARK
Jenkins Bros.

# Reader service section

## *Start with these quick samples . . .*

### Power for peace . . .

is the goal of the Army's package power reactor. A paradox? No, because this unit, slated for completion in three years, will probably be Uncle Sam's first exportable peaceful application of atomic energy. Its components can be air-lifted to any part of the world. For first views released for publication, see Reports from the Field. . . . . p 152

### Abstract art . . .

puzzles a lot of us. But there's no puzzle about the art of abstracting as practiced in Technical Briefs. Here POWER editors scan the latest technical papers for you, boil them down for quick reading. This month's roundup gives you the heart of 15 reports on feedwater treatment, steam boilers, stack design, air pollution, controls, hydro development. And, if you need the full story, there's dope on how to get it. . . . . p 154

### High supercharge . . .

In a heavy-duty, relatively low-speed engine is news, says Worthington Corp, particularly when high supercharge means continuous operation at bmep's over 200 psi. At 200 psi, top rating of new design is 5000 hp. Feature item in Plant Equipment News gives facts and figures on this unit; other reports tell of problem-solving developments in meters, instruments, power rectifiers and pumps, to name a few. See. . . . . p 158

### On the level . . .

If it's control equipment you're looking for, check items 15 through 20 in this month's Free Literature. To order these, or any of the 60-odd bulletins described, use handy postcards. . . . . p 167

### Bet you don't know . . .

what a rope pump is. But a shaikh in French Tunisia did, and found a most unusual application for it—one that would have given its inventor, a Paris postman, some bad nights if he had heard of it. Out of all this comes a moral, as you'll see in George Edwards' Scrapbook. . . . . p 170

### Last roundup

Remember to check your Calendar of Events; stay abreast of changes in the power field by skimming Appointments; keep posted on helpful texts in Bookshelf. And don't miss next month's POWER—a special report on Motors packs a lot of information on horsepower into a 32-page frame.

***For other timely ideas, see following service pages ▶***

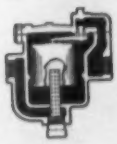
# Which type of steam trap is best for your need?

**1 Sarco Balanced Pressure Thermostatic**

Greatest capacity per dollar cost. Large air venting capacity. Same head and seat, 0-300 psi. Freeze-proof. Cat. 250-A

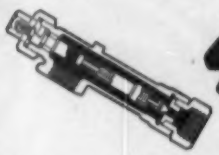
**2 Sarco Float-Thermostatic**

Discharges condensate continuously at steam temperature and without shock. Responds immediately to varying loads and pressures. Cat. 450-A



**3 Sarco Camlift Bucket**

New, powerful Camlift valve mechanism permits greater discharge with no increase in size of trap body. Cat. 360-A



**4 Sarco Liquid Expansion**

Adjustable to discharge condensate below 212°F. Freeze-proof. Not affected by water-hammer or pressure pulsations. Cat. 260-A

**5 Sarco Thermodynamic**

Valve head, a solid stn. st. disc, is only moving part. Same head and seat to 600 psi. Not affected by superheat, water-hammer, corrosive condensate. Cat. 255-A

*With these 5 different types to offer, Sarco can give you impartial advice*

Any type of steam trap will do "some kind" of a steam trapping job for you.

But there's a world of difference in trapping efficiency when exactly the *right* type of trap is used for a given application.

That's because both trapping conditions and the characteristics of different types of traps vary widely. There simply isn't any *one* type of trap that will do an efficient job under *all* circumstances. But there is always a particular type of trap best suited for each *specific* set of conditions.

That is why Sarco makes all 5 basically *different* types of traps. In a nutshell, it's to assure you of best trapping results at all times, regardless of requirements.

And don't overlook the very important fact that *only* Sarco makes all these 5 types — not merely variations of one type. Therefore, Sarco can give you absolutely impartial trapping recommendations, backed by 43 years of field experience. Call your local Sarco representative or write:

SARCO COMPANY, INC., Empire State Building, New York, N.Y. Represented in Principal Cities.

B8T1-B

**ONLY SARCO makes all 5 types of traps**

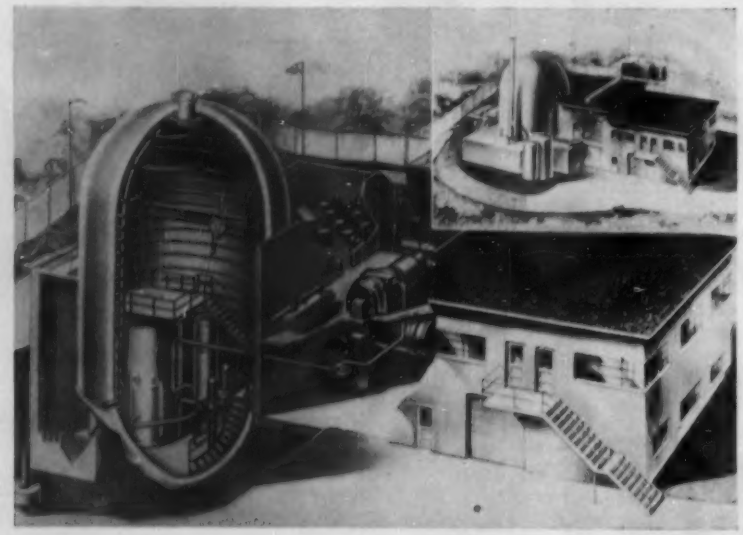
*—not merely variations of one type!*

SARCO SAVES STEAM

# REPORTS FROM THE FIELD

***What's happening in power and what it means to you***

For Calendar of Events see page 242



## Package power reactor ready in 3 years

► FIRST VIEWS approved for publication, left, show the Army Package Power Reactor designed by American Locomotive Co. It will be a prototype of the first atom-powered generating plant, built so its components can be transported by air to remote bases in any part of the world. ALCO is working under a contract received from the Atomic Energy Commission last Dec.

The U.S. Army's first atomic reactor will be erected at Ft Belvoir, Va., and should be in operation in about 3 years. It will probably be the nation's first exportable peaceful application of atomic energy.

## Giant self-powered pumping station controls Florida flood waters

► ONE OF THE WORLD'S largest self-powered pumping stations is operating as the heart of a gigantic water-control system, aimed at taming flood waters of the Florida Everglades.

Located at 20-Mile Bend, midway between Lake Okeechobee and West Palm Beach, the new station houses 6 116-in. Fairbanks-Morse pumps. Combined capacity is more than 3-billion gallons per day, enough to supply the average daily water consumption of 3 cities the size of New York. Water flowing from these pumps is equivalent to that of a river 500-ft wide and 10-ft deep flowing at the rate of 1-ft per second. Each pump is driven by a 10-cylinder, 1600-hp, 720-rpm opposed-piston diesel engine, also manufactured by Fairbanks-Morse Co. The plant can function even during hurricanes when electric power lines are disrupted.

The State of Florida paid 40% of the costs of the water-control project which was a cooperative effort of local, state and federal agencies. Purpose was to end the threat of drought and make it possible to reclaim millions of acres of rich farm lands.

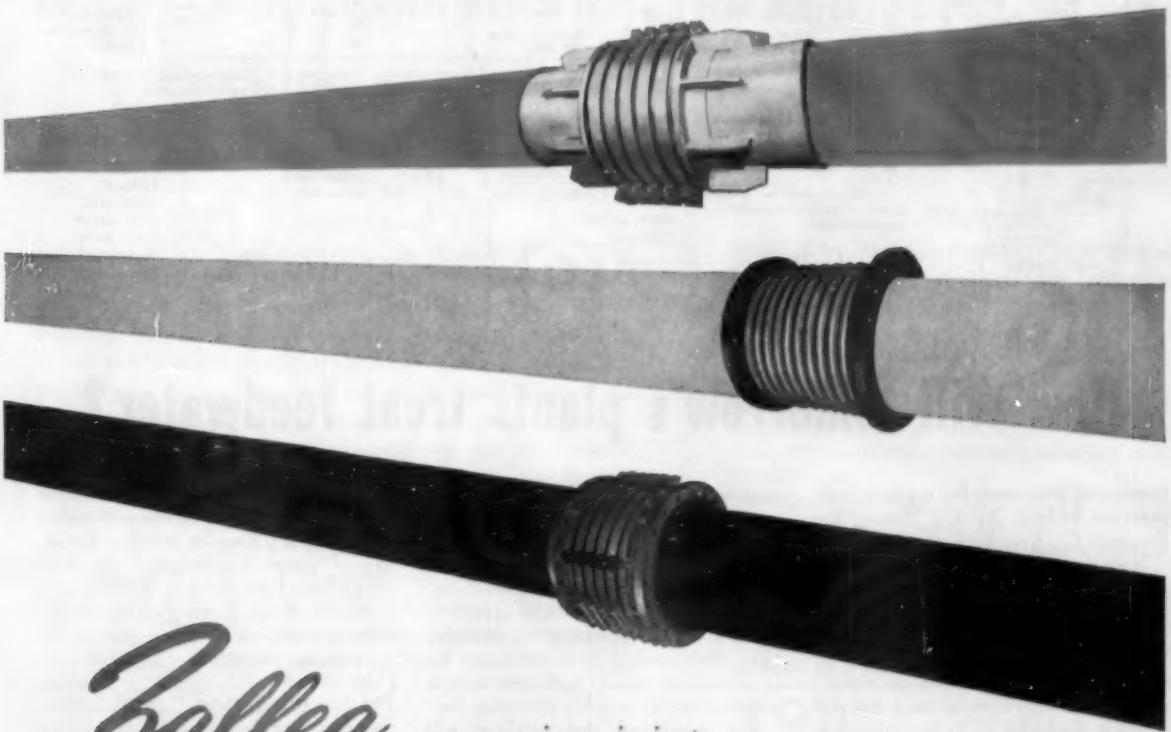
Aerial view of Station 5A, right, shows how water is taken through a short cut-off from the West Palm Beach Canal in the foreground and discharged to the conservation area to the rear. The station was placed in operation last March.

(*More Power News on page* 238)

The true cost of an expansion joint is not the figure on the manufacturer's price tag. Many factors enter into any such cost determination. For example, an expansion joint that fails just when it shouldn't could wreck a plant and cost a small fortune. And, assuming equal first-cost of any two competitive manufacturers' designs, one that stands up twice as long as the other . . . costs only half as much on a unit-time basis. So, one really shouldn't count on "price" as a measure of value.

But here is one thing you can count on. Every single expansion joint in the Zallea line is designed and built to assure maximum reliability —and top value for your dollar. This is no empty boast, but a fact that can be confirmed for you by figures.

So, whenever you have problems—or needs—relating to expansion joints, don't fail to get in touch with Zallea. Write today for Bulletin 351, containing condensed descriptions of the many types. There is a Zallea joint for every requirement.



**Zallea** *expansion joints*

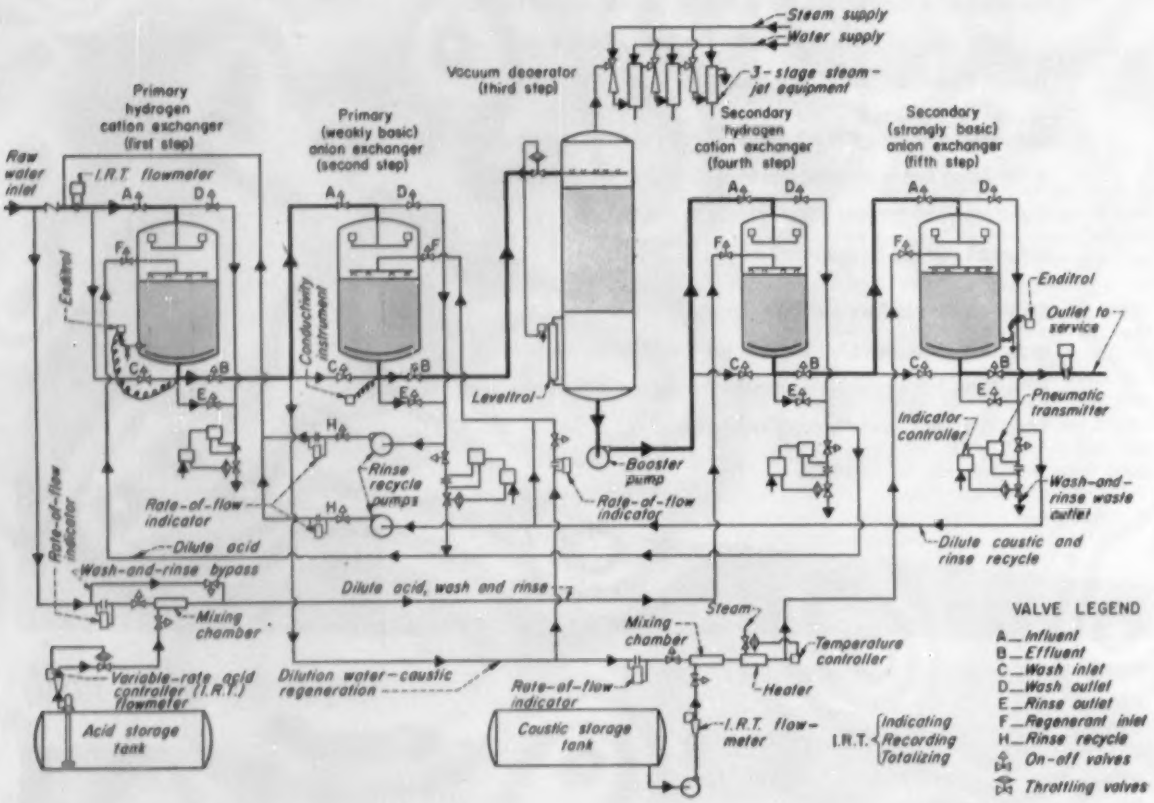
ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

*World's Largest Manufacturers of Expansion Joints*

# TECHNICAL BRIEFS

***Latest engineering developments for busy power men***

**15 Digests for you on:**
**WATER TREATMENT**
**STEAM BOILERS**
**STACK DESIGN**
**AIR POLLUTION**




# How will tomorrow's plants treat feedwater?

**Feedwater treatment for modern high-pressure boilers.** *By J D Yoder, The Permutit Co, New York, New York.*

Higher boiler-plant efficiencies achieved during the last 25 years are chiefly the result of increased pressure, steam temperature and use of reheat. Prior to about 6 years ago, makeup for these plants was softened or evaporated in an endeavor to hold mineral solids in the boiler water to a minimum.

Now it is possible to secure the equivalent of distilled water by demineralization with the ion-exchange process. This paper discusses treatment of makeup by ion exchange for plants with both small and large makeup needs. Factors discussed include history of the process, principles of operation, equipment arrangement, mixed-bed demineralization, supercritical pressures and nuclear power reactors.

Diagram above shows a typical arrangement for a 5-step demineralizing plant arranged for automatic operation. It has a vacuum deaerator for removing $CO_2$. This hookup is well adapted for large-capacity plants requiring a high degree of purity at a low operating cost.

The mixed-bed demineralizer will probably fill an important need in boilers operating above the critical pressure because it appears advisable to reduce all mineral solids to the minimum. It may also have definite advantages for the nuclear power plant since freedom from electrolytes in the water is of much importance. *MVEA paper; no number.*

**The treatment of sewage plant effluent for water reuse in process and boiler feed.** *By R J Keating and V J Calise, Graver Water Conditioning Co, New York, New York.*

Despite severe shortages of water for industrial purposes in many parts of the country, the possibility of using sewage-plant effluent is frequently overlooked. The fact that several plants have successfully used such reclaimed water for a period of years should stimulate greater interest in this process.

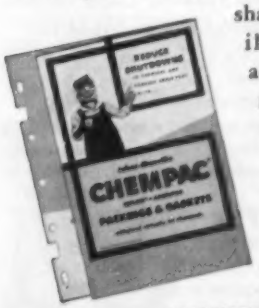
To a great degree, neglect of this important water source is (1) result of lack of awareness of its availability, (2) possibility of satisfactory purification for industrial use. Other important rea-

(*Continued on page 156*)

# Now—J-M Chempac-Interlocked Packing combines both "Teflon" and asbestos protection

Johns-Manville now introduces Chempac®-Interlocked Packing, with three important advantages for service in chemical and process equipment. Interlocked provides the excellent sealing and heat resistant qualities of asbestos. It is braided by the unique and exclusive J-M method, so that the asbestos yarns are securely interlocked and cannot come apart in service. And it is treated with chemically inert Teflon*, which is almost universally resistant to chemical and solvent action.

Chempac-Interlocked can be used to pack pump rods or shafts, rotary filters, mixers and similar apparatus handling strong acids, alkalis, caustic solutions and many other reagents at temperatures to 500F.




**Other J-M Chempac Packings and Gaskets for the Chemical and process industries**

**J-M Chempac Packings** in coil, spiral and ring form. Made of asbestos, treated with Teflon, they are available in types for caustic, acid, chlorine and solvent service.

**J-M Chempac Gaskets** with Asbestos-Teflon base. They have high mechanical strength and heat resistance, with excellent sealability at low bolt stresses.

**J-M Chempac Folded Gaskets** designed for glass lined equipment. Asbestos-Teflon base gives them high sealing effectiveness against a wide range of chemicals.

**J-M Chempac Spirotallic Flange Gaskets** for perfect sealing in high temperature and pressure service, constructed of interlocked plies of metal and Teflon-Asbestos.

*Trade Mark of DuPont Tetrafluoroethylene resin

***Free Folder*** gives complete details on Chempac-Interlocked and other J-M Chempac Packings and Gaskets for the chemical and process industries. For your copy of folder PK-80A write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE PRODUCTS

**Johns-Manville PACKINGS & GASKETS**

# More TECHNICAL BRIEFS

Begins on page 154

## Water treatment

Continued from page 154

sons for neglect include the difficulty of negotiating contracts satisfactory to both municipalities and industrial users for the supply of effluent; certain technical problems which need further study; and, not least significant, an esthetic reluctance to accept effluent as a potential source of water for any purpose at all.

Four conditions necessary for practical reuse of sewage-plant effluent by industry are: (1) there must be a local industry needing water for processes that do not involve public health, (2) municipal sewage-treatment plant must be large enough to supply these requirements, (3) costs for processing, including transportation to the point of use, must be less than the cost of alternate supplies, (4) municipal plant must be able to deliver a reasonably consistent quality of water suitable for reuse by the particular industry.

In terms of applicability of effluent for reuse, sewage plants can be divided into three broad categories: (1) primary treatment, (2) primary treatment plus trickling filters, (3) primary treatment plus activated sludge.

There are five main differences between most sewage-plant effluents and typical surface or well-water supplies —higher color, higher nitrogenous content, higher bod content, higher total dissolved solids, and the presence of phosphates, due to detergents. The paper discusses these factors and describes two successful effluent-treatment installations. *Paper no. T-129.*

**Hot process-hot zeolite treatment in a steel mill.** *By J P Katzenmeyer, United States Steel Corp and M Lane, Graver Water Conditioning Co.*

This paper describes the water-treatment installation for two new boilers at The Ohio Steel Works. Since a number of alternate supplies were available, the choice of makeup source required a comprehensive study of the various waters and their characteristics. Details of this study, given in the paper, are both interesting and useful.

The hot process-hot zeolite plant installed is designed to furnish zero-hardness, low-alkalinity, zero-oxygen water. Design capacity is 400,000 lb per hr. This installation is well detailed in the paper. Interesting sidelights include plant performance and personnel training. *Paper no. T-128.*

Directions for ordering papers are given on page 224

# Recent papers give modern thinking on superheater design, packaged-boiler controls and development

**Superheater metal temperature.** *By G Parmakian and N S Sellers, Riley Stoker Corporation.*

One of the critical problems in design of modern steam generators is selection of materials for high-temperature high-pressure superheaters and reheaters. Perhaps the most important single factor in superheater-material selection is temperature. Effect of temperature is also prominent in evaluation of the corrosion and oxidation resistance of steels.

A designer can determine wall temperature of a tube subjected to heat transfer if the following variables are known; temperature of each fluid, outside and inside film coefficient of heat transfer, thermal conductivity and thickness of tube wall, and thermal conductivity and thickness of deposit layers at the inside and outside surfaces of the tube.

In superheater design the problem becomes more involved because a large number of elements are placed parallel to each other. More than one steam circuit indicates that no two elements will have exactly the same steam flow, temperature, and film coefficient of heat transfer. In the same manner, outside surfaces of the tubes are subject to combustion-gas flow varying in temperature and film coefficient of heat transfer from element to element.

All these factors must be evaluated by the designer to predict temperature of the inner and outer skin of the superheater tube wall. The paper discusses these factors, using examples to illustrate them. *ASME paper no. 54-A-181.*

**Selection of control equipment for packaged watertube steam generators.** *By A W Hindenlang, Combustion Engineering, Inc.*

Versatility and economy of the packaged watertube steam generator for pressurized-gas and oil firing have had a marked impact on the industrial boiler market. Their resulting widespread acceptance has led to considerable discussion of the type of control and protective equipment best suited for them.

A number of varying factors tend to complicate selection of control equipment and safety devices that exactly suit requirements of all potential users. Yet, the practice of custom engineering each individual control system entails the loss of all advantages of purchasing a standardized product.

To insure retention of these benefits, packaged control systems are offered in standard, performance-proven combinations of the various components. Most of the tedious detail work is eliminated.

Among factors influencing the ultimate control selection are local codes and ordinances, insurance regulations, initial and operating costs, nature of plant load, type of fuel burned and degree of training of maintenance personnel. The problem may be reduced to three basic decisions.

The three considerations fundamental to all control and protective systems for oil- and gas- or combination-fired watertube steam generators are: flame-safeguard control—automatic or semi-automatic, limit controls—how many, combustion controls—metering or positioning. The paper discusses each of these in detail. *ASME paper no. 54-F-29.*

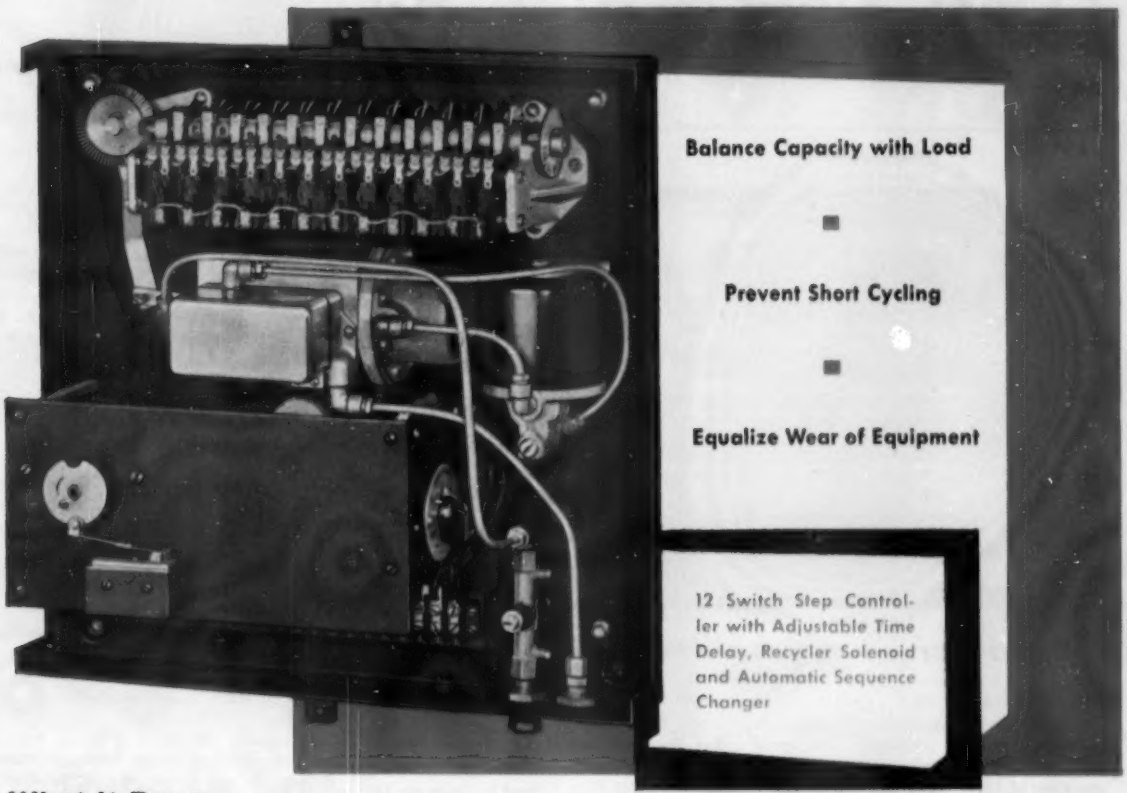
**Recent developments in packaged firetube boilers.** *By F A Loebel, Cleaver-Brooks Company.*

Packaged firetube boilers, introduced about 20 years ago, were well received. They seemed to fill a growing need and came to be sought more and more by users. About 1936, industrial demand appeared for burners to handle cheaper fuel grades, namely No. 5 and 6 oils.

Though many types of burners were supposedly available for these grades, it soon became apparent that the availability was limited to parts, not the entire unit. There was no commercial

(*Continued on page* 216)

# JOHNSON PNEUMATIC STEP CONTROLLER FOR CAPACITY CONTROL OF REFRIGERATION MACHINES



**Balance Capacity with Load**

■

**Prevent Short Cycling**

■

**Equalize Wear of Equipment**

12 Switch Step Controller with Adjustable Time Delay, Recycler Solenoid and Automatic Sequence Changer

## What It Does

This new and improved controller is designed to accomplish, with a single compact unit, everything that is desired for the control of multiple step refrigeration installations, including "on" and "off" operation of the steps in sequence, positive prevention of the starting of more than one compressor at a time after night shutdown or after current failure, and manual or automatic changing of compressor operating sequence to equalize wear. It can be used to control one or a group of refrigeration machines. It completely eliminates all the disadvantages of a series of separate pressure switches.

## How It Works

The Johnson Pneumatic Step Controller, responding to changes in control pressure from a Johnson Pneumatic Thermostat or other regulator, actuates a number of separately adjustable, snap-acting, single-pole, double-throw switches in any desired sequence. Control arrangements include (1) starting and stopping two or more compressors in sequence, (2) operation of cylinder unloaders in sequence, or (3) a combination of (1) and (2).

## Special Features

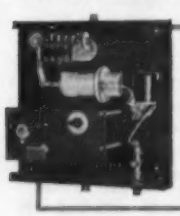
**Recycler and Time Delay**—Recycler Solenoid immediately returns all switches to their normal position on shutdown or current failure. Time Delay assures the proper interval between successive switch operations on start-up or when current is restored after failure.

**Sequence Changer**—Varies the starting sequence of compressors to equalize running time and wear. Step Controllers are furnished with either Manual or Automatic Sequence Changer.

**Models**—Choice of 4, 6, 8 and 12 switch units, with or without special features such as Recycler, Adjustable Time Delay and Sequence Changer.

* * *

Installation and operation of the Johnson Pneumatic Step Controller is both simple and inexpensive. A nearby Johnson engineer will gladly explain, without obligation, how it can best solve your special problems, or write today for full details.



**OTHER APPLICATIONS**

Johnson Step Controllers are also used to control multiple fan or pump installations, electric heaters and other systems where electrically actuated devices are to be operated in sequence from a proportional acting pneumatic controller. Send the coupon for more facts.

**JOHNSON CONTROL**

TEMPERATURE AIR CONDITIONING

**PLANNING • MANUFACTURING • INSTALLING • SINCE 1885**

**JOHNSON SERVICE COMPANY**
**507-5 East Michigan St., Milwaukee 2, Wisc.**

*Please send me Apparatus Bulletin G-180 describing specifications, features and application of Johnson Pneumatic Step Controllers.*

NAME _____

FIRM _____

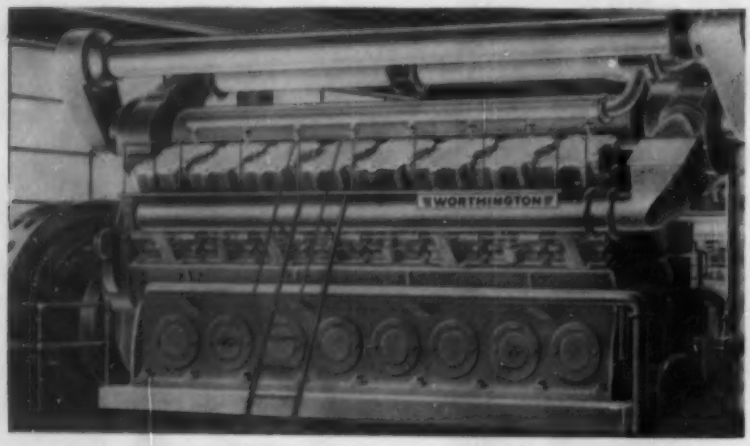
ADDRESS _____

CITY & STATE _____

# PLANT EQUIPMENT NEWS

***Your information center for new products designed to solve plant problems***

Published monthly as a service to readers




## Supercharged engine rated at 1360-5000 hp

**500** • Four-cycle high-pressure supercharged engine is generally recognized to be first heavy-duty relatively low speed engine in the U.S. designed for continuous operation at brake mean effective pressures beyond 200 psi. At 200 psi, the top rating is 5000 hp.

Cylinder combinations are 6, 8, 12 and 16. Six and 8-cylinder engines are built in line, while 12 and 16-cylinder units are V-type. They are 14-in. bore by 18-in. stroke. For this bore and stroke, present rotative speed of 450 rpm is conservative and piston speed is only 1350 fpm.

The unit is available as an oil diesel, dual fuel diesel, spark ignition gas, or tri-power engine. All operate on diesel compression cycle and can be converted to other types without alteration of piston and cylinder heads.

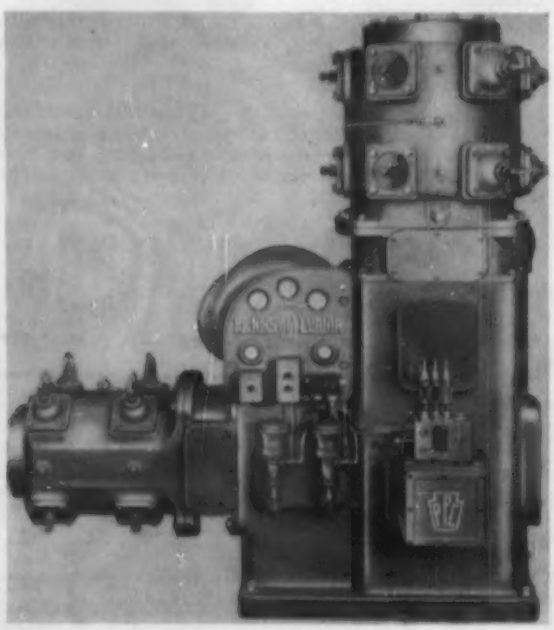
Oustanding feature, according to manufacturer, is interchangeability of major parts between the in-line and V-engines. The same governor, cylinder heads, cylinders, pistons, connecting rods, bearings, fuel injection equipment and miscellaneous small parts are used for all cylinder combinations.

Combustion system is designed around a high-pressure turbocharger with conventional valve control and minimum air cooling requirements. Discharge pressure is 8-10 psig. This permits use of a comparatively small air aftercooler and reduces cooling water requirements far below that of engines using much higher charging pressures, manufacturer states.

Exhaust and air manifolds are on opposite sides of the engine. On V-engines, this places exhaust manifold between cylinder banks and air manifolds on outside along the coolest part of the frame.

Cast-in water jackets are baffled for even distribution of circulating water and for high velocity cooling. Circulating water is entirely outside of engine frame, preventing electrolysis and frame corrosion and eliminating possibility of contaminating the lubricating oil. Further information available on request to the manufacturer.

**Worthington Corp, Harrison, N. J.**



## Two-stage angle air compressors

**501** • Two-stage angle water-cooled air compressors are available in 125 and 150 hp, for pressures to 125 psig. Piston displacement is 797 and 974 cfm.

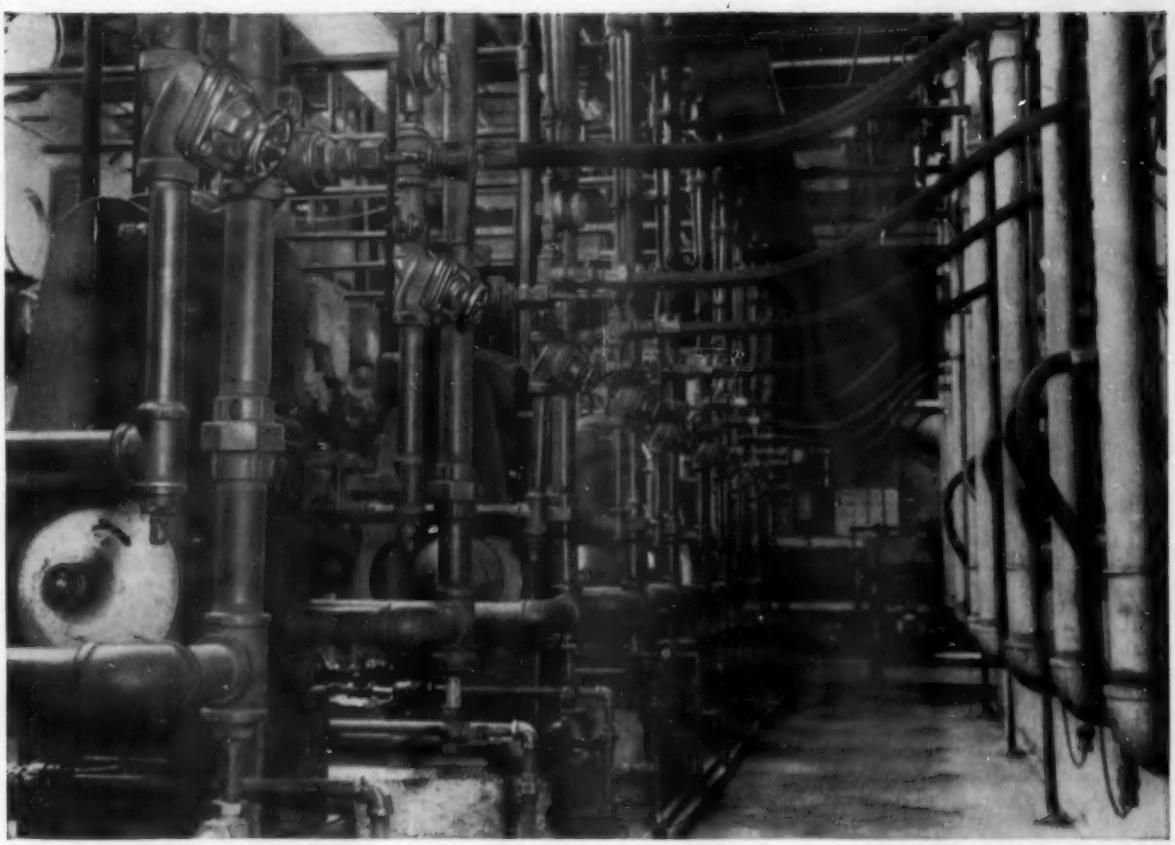
Among features claimed by manufacturer is flexibility of installation obtained by use of reversible distance-pieces, located between air cylinder and main frame. Containing the suction and discharge-openings, these distance-pieces can be mounted right or left to allow intake and discharge to open on either side of the frame.

Water-in-tube type intercooler permits replacement of individual tubes without replacing entire assembly. The integrally-finned tubes are rolled into tube sheets with a floating head on one end to accommodate expansion and contraction. An automatic condensate drain, operating on the float valve principle, is a built-in feature of the intercooler.

Control of the compressor to meet fluctuating demands for air results from 3-step regulation by which unit automatically operates at full-, half- and no-load capacity. This system consists of lifting inlet valves and allowing air in the cylinder to pass freely in and out instead of being compressed. Inlet valve unloaders used in this method of regulation, are operated by 2 pilot valves mounted on the control panel. Further information in bulletin 602.

**Pennsylvania Pump and Compressor Co, Easton, Pa.**

To obtain additional information on these new equipment items, use the post cards on page 167. Identify your request with item number.



# Holding high vacuum with low upkeep is routine for these CRANE VALVES

At the Crosley & Bendix House Appliance Divs. Avco Mfg. Corp. refrigerator plant at Richmond, Ind., a line vacuum within a few microns of absolute is applied to a dehydration process. But holding this vacuum wasn't always a routine operation. There was a time when frequent valve failures caused production losses and costly maintenance—stopped only when Crane Packless Diaphragm Valves were installed.

Of the valves formerly used, a multiple metal diaphragm type lasted about 3 months. Crowning of diaphragms caused restriction or closure and made the valves inoperable. Damaged diaphragms meant complete valve replacements. In other valves, in-leakage at the diaphragm-to-stem connection made them unsatisfactory.

Now in service more than a year, none of the Crane Kel-F Diaphragm Valves have needed any maintenance. Their simplified construction, giving a longer-life diaphragm . . . tighter bonnet seal and seating . . . and easier operation . . . is the reason. And that's typical of Crane quality . . . always the bigger value for thrifty buyers of valves and fittings. General Offices: 836 S. Michigan Ave., Chicago 5, Ill. Branches and Wholesalers Serving All Industrial Areas.

**CRANE NO. 1610KF PACKLESS DIAPHRAGM VALVES**

The diaphragm in Crane design has longer life because it seals the bonnet only—is not subject to the cutting and crushing encountered when also used for seating. Makes a tighter bonnet seal—while separate, positive seating disc controls fluid even should diaphragm fail. Wide selection of body materials and trims. Write for circular AD-1942 or get it from your Crane Representative.

# CRANE CO.

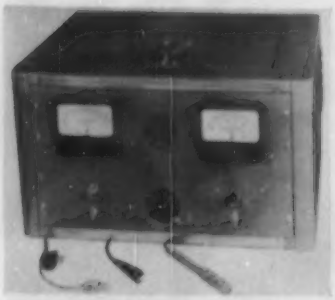
VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

# More EQUIPMENT NEWS

Begins on page 158

## Meters and instruments—6 recent developments



### Dielectric testing unit

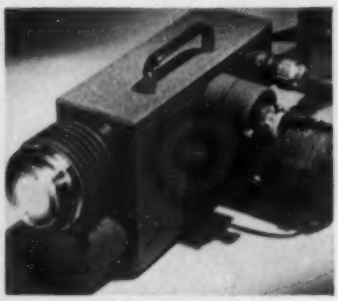
**507** • Instrument is used for dielectric testing to 5000 volts dc, and for insulation resistance measurement to 50,000 megohms. Output current ranges of 0-5/10/50/100 microamperes are indicated on a 4½-in. microammeter that is electronically protected against overload. Continuously variable output voltage of 0-5000 volt dc is read on a 4½-in. voltmeter. Ac ripple at rated voltage and current is less than 1%, manufacturer states. Unit is arranged for standard rack and panel mounting. Dimensions are 22x14¾x12 5/16-in.

**Associated Research Inc, 3770 W Belmont Ave, Chicago 18, Ill**

### High-current test set

**508** • Portable instrument is designed for testing and calibrating overload relays, meters and circuit breakers. It permits safe and speedy trip-time checks on electrical protective devices before installation or while in line. The unit produces primary currents, adjustable in stepless increments, that pass only through devices under test. Built-in ammeter and electronic stop timer give complete data of protective device's behavior under simulated operating conditions. Descriptive bulletin available on request to manufacturer.

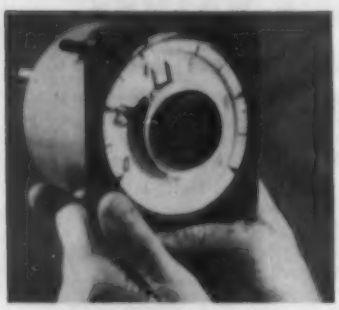
**Multi-Amp Corp, 10 3rd St, Newark 5, New Jersey**



### Pressure-transient recorder

**509** • Through use of interferometric optical principles, unit can record short-term pressure variations over a wide series of pressure ranges. The film record produced is suitable for rapid analysis and data reduction—a first approximation of pressure being available by counting the number of fringes. The instrument can be used in 3 ways: (1) exposed to free air manifestations, (2) attached directly to a pressure vessel, (3) fed by a hydraulic line from the pressure source. Further details on request.

**Beckman & Whitley Inc, 860 E San Carlos Ave, San Carlos, Calif.**



### Control initiating device

**510** • Instrument is an automatic, all-electrical device for initiating action when a predetermined value is reached. It is installed on switchboard or panel instruments. Photo above shows the dial component of the device.

Typical applications include: (1) to sound alarm when controlled temperature reaches critical value, (2) to initiate control to contain cycles per second within a specified range, (3) to shut down equipment at a maximum vibration point, and (4) to shut down machinery drawing too much power.

**General Electric Company, Schenectady 5, New York**

### 3½-in. panel instruments

**512** • Core-magnet, self-shielded panel instruments are available for dc or as ac retifier type instruments. Basic accuracy, according to manufacturer, is within ± 2% of full scale range for dc instruments, and ± 3% for the ac rectifier types. The instruments can be mounted close together without any inter effect. They also can be mounted on magnetic or nonmagnetic panels interchangeably, without need for special adjustment. Available in 3½-in. size in both round and rectangular shapes.

**Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark 5, New Jersey**

### Contact-type controller

**511** • Instrument continuously indicates any electrical variable and provides accurate high or low limit control. It can also be used as a continuous control with automatic reset.

Manufacturer reports that no magnetic contacts or locking coils are used. Reset can be remote and does not require manual lever or solenoids. Unit is portable but can also be furnished for wall or panel mounting. Knob located on outside of case provides adjustment of contactor over entire scale range. Further details on request.

**Larson Instrument Company, 24 Orchard St, Tarrytown, N. Y.**

For more data on these items, use post cards page 167. Identify your request with item number.

Boiler Refractories
Bulletin R-36
CONTENTS:
How important are Refractories?
Discussion of basic requirements of refractories and critical refractories areas in boilers. PAGE 3
What causes Refractories to fail?
Includes discussion of hot load strength, spalling, shelling, slagging, abrasion, erosion, shrinkage and expansion. PAGE 5
Description and Properties of:
FIREBRICK PAGE 7
INSULATING FIREBRICK PAGE 9
REFRACTORY CASTABLES PAGES 11 AND 12
REFRACTORY PLASTICS PAGES 14 AND 15
REFRACTORY MORTARS PAGES 14 AND 15
Marine Boilers PAGES 16 AND 17
Ashpit Refractories PAGES 18 AND 19
PAGE 10
PAGE 2
PAGE 19
PAGE 4
PAGE 8
PAGE 18
PAGE 16
PAGE 17
PAGE 9
PAGE 6
New 20-page Handbook
FOR SELECTING BOILER REFRACTORIES
Contains detailed discussions of critical refractories areas in both refractory-lined and water-cooled boilers. Your local B&W Representative will be glad to send you a copy. Just ask for Bulletin R-36.
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General Office: 161 East 42nd Street, New York 17, N. Y.

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R-933

# More EQUIPMENT NEWS

Begins on page 158

## Germanium and selenium power rectifier units

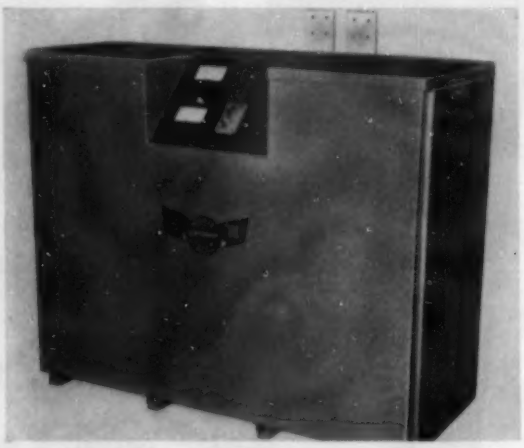
### Germanium rectifier: 125 v, 25 amp dc

**502** • This tubeless germanium unit contains no moving parts and is claimed to be unique due to its compactness, lightweight and inherent regulation of 4% from no load to full load.

Dc output is 125 v at 25 amps; ac input is 230 v, 60 cycle, 3 phase. Efficiency at full load is 94%, power factor is 98%. Tap switch gives output voltage adjustment over range of 115-125 v for normal line and load variations.

Weight of the unit is approximately 125 lbs. Dimensions are 22-in. wide, 15-in. deep, 19-in. high. Details on request.

**Perkin Engineering Corporation, 345 Kansas Street, El Segundo, California**

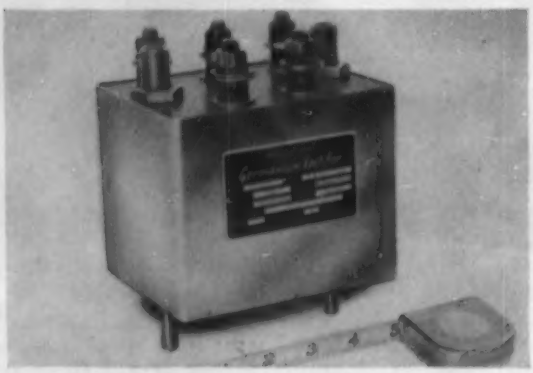


### 95% efficiency claimed for germanium units

**503** • Germanium rectifiers, said to have 95% efficiency at full load, are available in several models from 300 to 50,000 amps dc output. High efficiency is accomplished by low forward resistance, high inverse resistance and negligible heat generation of the germanium junction.

Manufacturer states that in voltage stabilization tests, a minimum voltage variation of less than 1 volt has been maintained when operating from no load to full load. The complete rectifier units are almost 100% sealed from adverse atmospheric conditions. Full information available on request.

**Rapid Electric Co, 2881 Middletown Rd, New York, N. Y.**

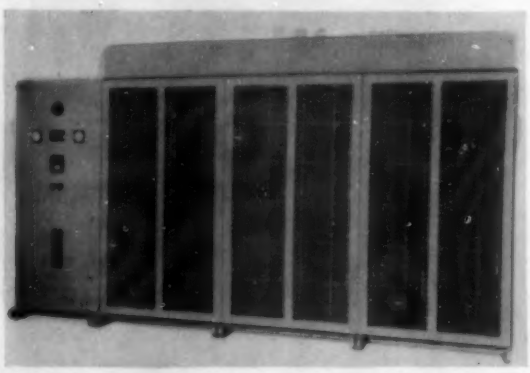


### 35-kw liquid-cooled germanium rectifiers

**504** • This 3-phase bridge unit, rated for a maximum of 450 amps dc continuous output, can be supplied for input voltages of 26, 36, 52 and 66 v, rms, maximum. Manufacturer states that efficiencies to 97% are attainable and power factor is essentially 100%. Rectifier regulation as low as 2% is possible from no load to full load. Aging is negligible or zero.

Unit requires liquid coolant (water, oil, etc) at a maximum inlet temperature of 25 C and volume of ½ gpm minimum. Unit volume is approximately 220 cu in. Sizes may vary slightly with rating. Complete information on request to manufacturer.

**International Rectifier Corp, El Segundo, Calif.**



### Selenium rectifier unit is rated at 600 kw

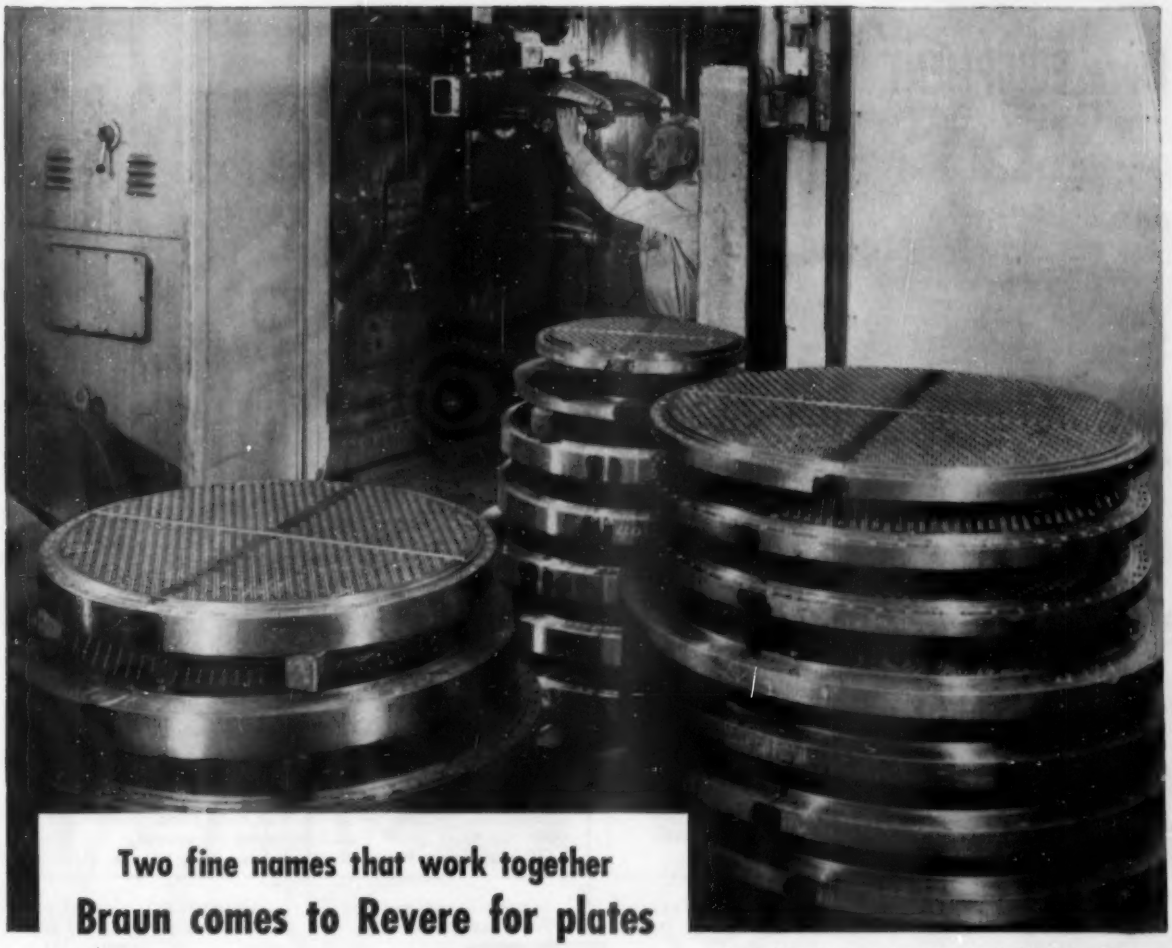
**505** • Power unit, housing rectifier stacks, control components, fans and dc circuit breaker, consists of a sheet metal cubicle approximately 6-ft wide, 7-ft high, 15-ft long. It is sectionalized into 4 sub-assemblies for ease in handling and shipping.

The unit has a 600-kw capacity and converts 13,200 v, 3 phase, 60 cycle ac to regulated 250 v, 2400 amp dc for operation of rolling mills in an Eastern Pennsylvania plant.

Unit has auxiliary components to provide over voltage, over current and over temperature protection. The rectifiers are forced air cooled by six 24-in. fans. Full details on request.

**Syntron Company, Homer City, Pennsylvania**

For more data on these items, use post cards page 167. Identify your request with item number.



Tube sheets at 4-spindle automatic drill in Braun shop.

## Two fine names that work together

# Braun comes to Revere for plates

C. F. Braun & Co., Alhambra, Calif. is well known in the petroleum industry, the chemical industry, and other businesses in which heat transfer and fractionation are vital. Revere Copper and Brass Incorporated is well known in the non-ferrous metal industry for its tube sheets and plates, in all the customary alloys. What is more natural than the close relations between the two companies, Revere the supplier, Braun the fabricator? Revere can furnish heavy plates when needed; Braun is one of the great heavy-duty shops of the country. So far as transportation limits permit, Braun fabricates in its own plant; their machines and their cranes can handle anything the railroads can haul away. The same is true of Revere, which is likewise known throughout heavy industry for its ability to produce not only large plates, but also condenser and heat exchanger tubes.

Revere is pleased to be an important supplier to Braun. Remember, good names find it good business to come together. The next time you want quotations on tube sheets and plates, and condenser tubes, get in touch with the nearest Revere Sales Office.

A Braun engineer inspects a drilled tube sheet.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

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* * *

*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.*
*Sales Offices in Principal Cities, Distributors Everywhere.*

# More EQUIPMENT NEWS

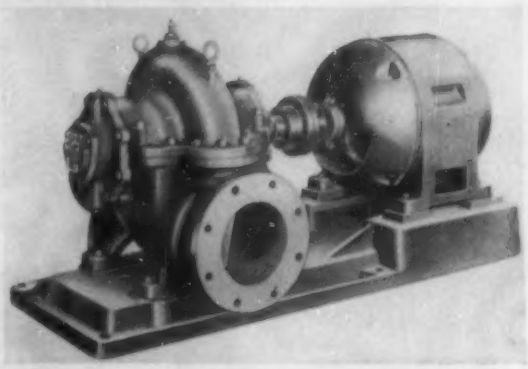
Begins on page 158

## Five possible solutions to your pumping problems

### Turbine pumps for boiler feed service

**513** • Regenerative two-stage turbine pumps are designed for boiler feed service with boilers to 1000 hp, operating at pressures to 300 psi. They are equipped with low pressure stuffing boxes, obtained by use of a throttle bushing under stuffing box and a bleed-off arrangement back to the pump's low pressure area. This arrangement is said to enable operator to pack for low pressures while pump is operating against highest obtainable differential heads. Balanced shaft loading is also provided by opposing discharge of the first and second stages. Available in standard fitted, bronze fitted, all iron, and all bronze construction. Bulletin 107 contains full information.

**Roy E Roth Co, 2420 4th Ave, Rock Island, Ill.**



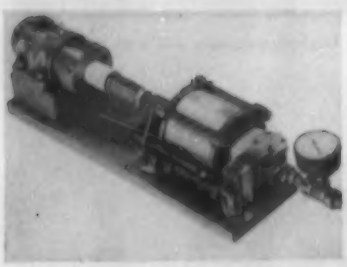
### Centrifugal pump has mechanical shaft seals

**514** • Single-stage centrifugal pumps are designed with built-in double mechanical shaft seals. Greatest advantages, according to manufacturer, are lower maintenance resulting from elimination of packed stuffing boxes, and smaller space required for installation.

Close grained iron casing is horizontally-split with suction and discharge openings cast in the lower half. The bronze double-suction impeller is enclosed type, attached to the shaft by shrink fit method.

Standard equipment supplied with each pump includes air cock and drain plug. Full information on request.

**Pennsylvania Pump & Compressor Co, Easton, Pa.**

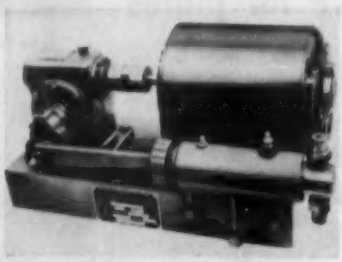


### Pneumatically-operated pump

**515** • Pneumatically-operated pump is designed for use in metering and proportioning small volume flows. It takes its power from a double acting air cylinder to provide quick starts and positive stops at high or low speeds.

Volume to be pumped is controlled by stroke length adjustment; and/or by controlling air supply pressure or speed of actuating the 4-way valve. For further information request bulletin UP-55 from the manufacturer.

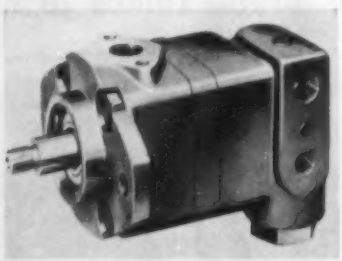
**Hills-McCanna Co, 3025 N Western Ave, Chicago 18, Illinois**



### Chemical feed pump

**516** • Controlled-capacity proportioning pumps are made in simplex and duplex types for feeding from 2 cc to 18.6 gph with maximum discharge pressures to 800 psi. Quality features claimed by manufacturer include: packing gland with external adjustment for positive packing compression (no springs); steel cross head running in bronze guide; forged or stainless steel liquid end; stainless steel piston and valve balls. Request catalog LP-1254.

**Philadelphia Pump & Machinery Co, 1513 Race St, Philadelphia, Pa.**



### Oil-hydraulic pump

**517** • Pump is designed for use in an accumulator system that provides oil-hydraulic power for cold starting of gas or diesel engines. It is adaptable to stationary, marine, or large mobile equipment such as construction, agricultural and road-building machinery.

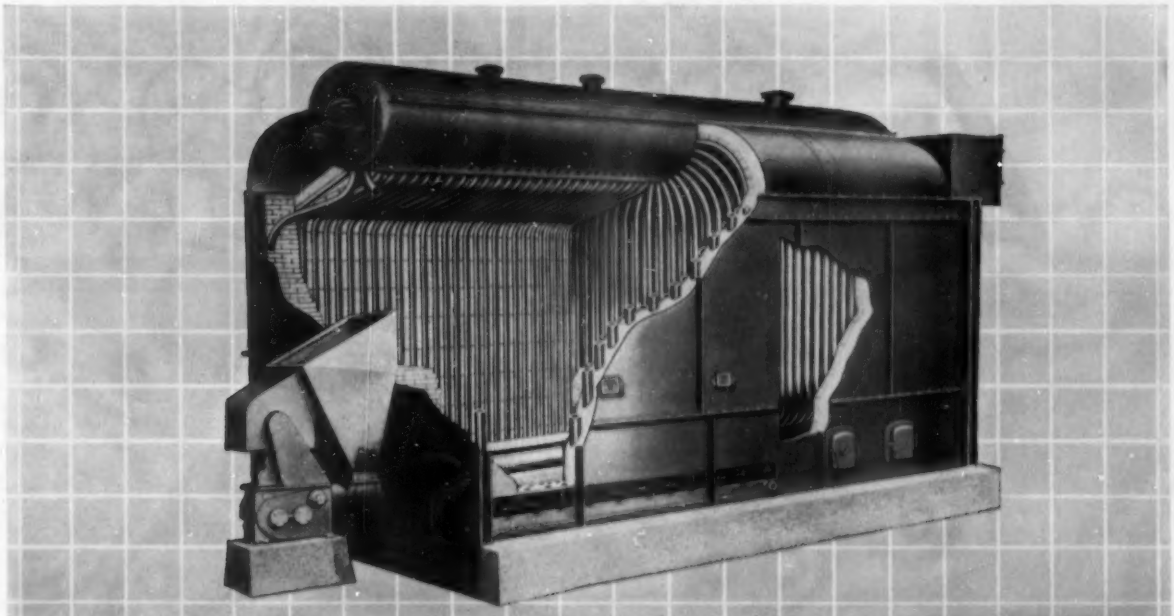
Pump includes integral unloading valve for compactness and system simplification. It is suitable for working pressures to 2500 psi and speeds to 3600 rpm. Details on request.

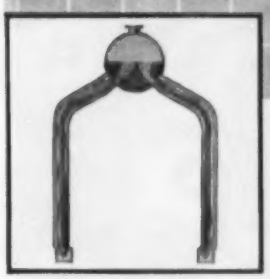
**Vickers Inc, 1400 Oakman Blvd, Detroit 32, Michigan**

For more data on these items, use post cards page 167. Identify your request with item number.

### CHECK THESE TOO . . .

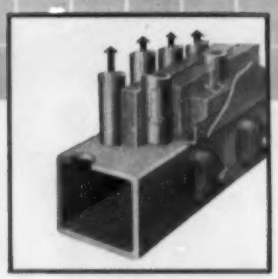

Union bonnet gate valves . . . . p 172
Liquid level control . . . . . p 174
Full flow oil filters . . . . . p 176
Water-cooled stoker . . . . . p 176
Diatomite water filter . . . . . p 178
Cylinder test stand . . . . . p 180
Dehumidifier-filter . . . . . p 182
Emergency safety lights . . . . p 182
Electric transmission system . . p 184
Close-coupled pump motor . . . p 186
Arc welding system . . . . . p 186



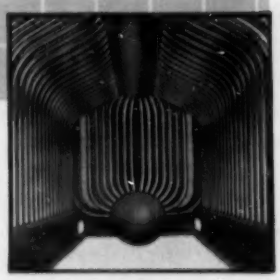


RING-FLOW CIRCULATION IN EACH WATER WALL ELEMENT

POSITIVE WATER SUPPLY TO WATER WALLS



WATER WALLS ACCESSIBLE FROM OUTSIDE THE SETTING



LOW FURNACE ROOF PROTECTS BOILER TUBES

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# ERIE CITY DESIGNS

The VL factory assembled or field erected, has EXCLUSIVE features that assure minimum furnace maintenance and a positive supply of clean water to the water walls. These EXCLUSIVE features are the result of many years of experience in designing and building two drum boilers; thousands of which are operating in the field today, giving users the satisfactory service they demand.

**WE PAY ROYALTIES TO NO ONE FOR THESE DESIGNS**

ERIE CITY
118 Years in Steam Generation

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**ERIE CITY IRON WORKS** • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
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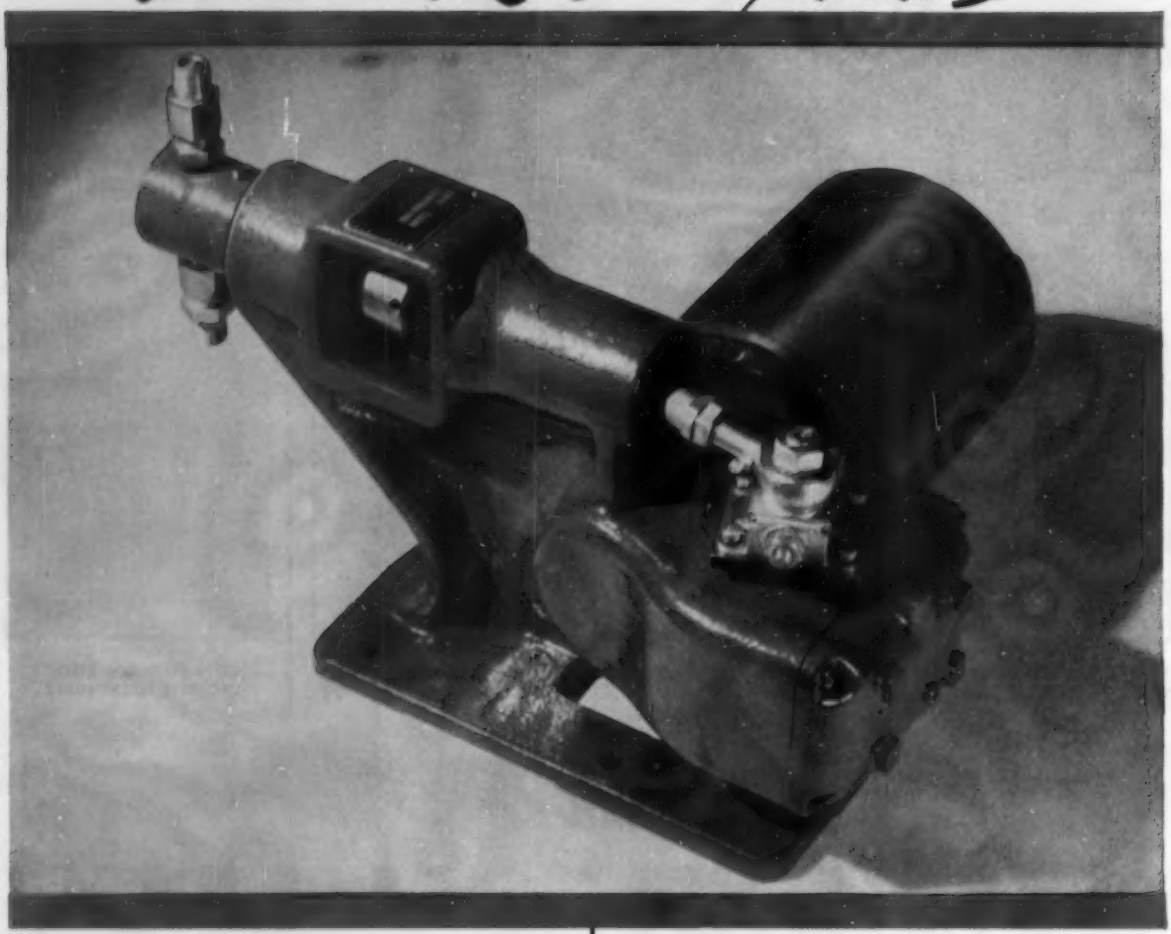
# Look!



**NEW CHEMICAL PROPORTIONING PUMP**

More pump for less money!!! Write for prices, capacities, and specifications on the new Proportioneers Model 1105-KH. Proportioneers, Inc., 354 Harris Ave., Providence 1, Rhode Island.

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DIVISION OF B-I-F INDUSTRIES, INC.

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## AIR CONDITIONING, VENTILATING, HEATING AND REFRIGERATION

**1** **Standard duty fans, *Class I and II.*** Design and construction data, arrangement and applications, capacity tables in illustrated 48-page bulletin 548. The New York Blower Co, 3155 S Shields Ave, Chicago 16, Illinois.

**2** **Ceiling diffusers and returns.** Square, rectangular and linear models described in 28-page bulletin F-6597. Includes dimension drawings, installation methods and performance data. Barber-Colman Co, Rockford, Illinois.

**3** **Air filters,** said to offer 99.95% or better efficiency on 0.3 micron particles, are described in illustrated 8-page bulletin 106. Cambridge Filter Corp, 738 Erie Blvd East, Syracuse 1, New York.

**4** **Suction heaters** for heating viscous liquids in storage tanks. Photos, specs, capacity charts in 8-page bulletin 54-79. ADSCO Industries, Inc, North Tonawanda, New York.

**5** **Adjustable-pitch fans** for cooling tower and heat exchanger applications. Photos, specs, capacities in 8-page bulletin A-111A. Hartsell Propeller Fan Co, Piqua, Ohio.

**6** **Six step manual** for sizing cooling tower pumps and piping. Sketches, selection charts, design tables, typical installations in 8-page bulletin GR-155 Bell & Gossett Company, Morton Grove, Illinois.

**7** **Liquid receivers,** for ammonia or freon, are designed for 250 lbs working pressure. Four-page bulletin LR-1 contains diagrams and full specs. Henry Vogt Machine Co, Inc, 1000 W Ormsby St, Louisville 10, Kentucky.

## BOILERS AND AUXILIARIES

**8** **Combustion control systems** for gas fired boilers are illustrated and described in 14-page bulletin MSA-116. Hagan Corp, 323 Fourth Ave, Pittsburgh, Pennsylvania.

**9** **Fly ash collection equipment.** Photos, schematic drawings, descriptions of electric precipitators, cyclones, fly ash and low draft loss collectors, combination systems in 8-page bulletin FA-102. Buell Engineering Co, Inc, 70 Pine St, New York 5, N. Y.

**10** **Pneumatic ash handling system** for small boiler plants is described in 4-page data sheet 2a. Includes line and schematic drawings, descriptions of essential elements of the system. The Allen-Sherman-Hoff Co, 259 E Lancaster Ave, Wynnewood, Pennsylvania.

**11** **Boiler settings.** Four-page bulletin 954 gives case history of increasing hp through modernization. Geo P Reintjes Co, 2517-19 Jefferson St, Kansas City 8, Missouri.

## COMPRESSORS AND ACCESSORIES

**12** **Gas-engine-driven compressors** in 330 to 660-hp range are subject of 44-page bulletin 2138-A. Photos, specs, cutaways, design features, typical installations. Ingersoll-Rand Co, 11 Broadway, New York 4, New York.

**13** **Non-portable compressors.** Article reprint RP-735 covers following topics: location, foundation-shaking forces, soil considerations, piping, location of inter and aftercoolers and receivers, lubrication, inspection and maintenance Worthington Corp, Harrison, N. J.

**14** **Application of ac motors** and controls to centrifugal compressors is subject of 12-page reprint 1130. Contains diagrams, charts, graphs, photos and formulas. Electric Machinery Mfg Company, Minneapolis 13, Minnesota

## CONTROLS, MECHANICAL & ELECTRIC

**15** **Pneumatic control** and transmission systems is subject of handbook-type 48-page bulletin 1136. Diagrams, tables, cutaways, complete specs. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pa.

(Continued on page 188)

Heat-treating and physical testing equipment shown at left is used for quality control of welding operators and for development of new welding procedures.

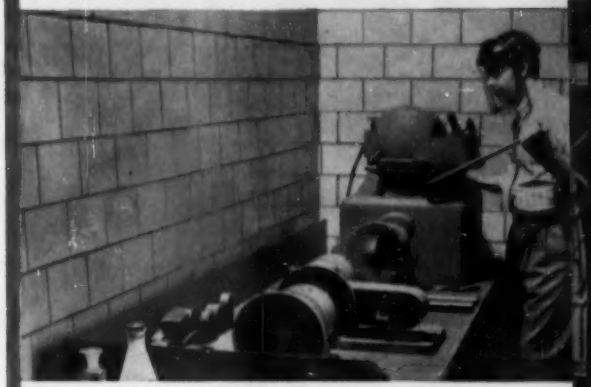
# Daily rigid testing is your insurance of quality welds in

# NAVCO FABRICATED PIPING

At Navco, a continuous parade of weld specimens are processed in the new, modern physical-chemical testing laboratory. It is here that weldments are studied metallographically and tested physically—all on a rigid schedule of quality control practices. Navco customers have benefited from progressive quality control practices for more than 40 years; they have come to know that piping installations, engineered, fabricated and erected by Navco, are precise, accurate and dependable.

*Call on NAVCO for your next piping job.*

▲ This Rockwell hardness testing machine measures the hardness of weld specimens as a guide to proper procedures for heat-treating of welds.



▲ A laboratory technician cuts a sample from a pipe weld prior to grinding and polishing for metallographic examination.

▲ Here a weld specimen is etched to outline the grain structure for further metallographic study.

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# George Edwards' Scrapbook

## You won't believe this

January issue of National Board of Boiler and Pressure Vessel Inspectors *BULLETIN* has this interesting item. After inspection of 1225 boilers in Kansas, 325 were found to have these faults:

| | |
|---|---|
| Condemned, unsafe beyond repair | 18 |
| Needing major repairs | 25 |
| Steam gage inoperative | 13 |
| Water glass, water column missing or inoperative | 81 |
| Operating without a safety release valve | 9 |
| Safety release valve stuck | 156 |
| Equipped with nonapproved safety valve | 7 |
| Piping to pressure controls obstructed | 300 |
| Blowoff facilities missing or inoperative | 12 |
| Requiring internal cleaning of scale and mud | 244 |
| Accumulation of scale at point of danger | 26 |

Needless to say, Kansas has no engineers' license requirements. Those 156 stuck safety valves make a power engineer shudder—and some of those boilers were in hospital plants. What is this, the Dark Ages?

## Work like hell

Happiness comes mostly from contentment, confidence, serenity, and active good will. Included is the pain of losing, as well as the pleasure of finding. It thrives best in a crowded life. Happiest men and women in history had more to do than they possibly could finish. Every waking hour of their lives was taken up by ambitious projects. These included literature, love, politics, science, friendship, commerce, professions, trades, religious faith, and countless other matters. If you're unhappy, try working hard, getting interested in as many activities as you can. Then you won't have time to be unhappy because you will be useful to yourself—to others.

## Are you complacent?

C Hautau startled everyone with his comment at the last Industrial Management Society meeting: "Assume you possess years of tradition, a good, fixed product design, plenty of know-how, an up-to-date plant, so what? You're stuck because a company without all your know-how and equipment will set up an automation line to build a redesigned product, and wipe you out on the basis of his low price. He won't have the handicap you have."

Moral here is that we had better not rest on our past good record. It's kind of sad that we can't stop and rest once we build a good reputation, but that's how it is. Technology is moving too fast for us to even think of a breather.

## Forget this rope trick

Heard of a shaikh, in French Tunisia back in the old days, who amused himself by sentencing his enemies to a parched section of his mountains. Only drinking water was in a very deep well that had very little water. And only way to get water was to turn the crank of a rope pump.

If you haven't heard of a rope pump, it was invented by a Paris postman named Vera in 1781. He was awarded 2400 francs by the Academie Royale Des Sciences for this job. Pump was revived about 1910 by M Bessonet-Favre, under the name of Chaine-Helice Water Elevator. Here a chain-wire combination was used to entrap the water. Efficiency of 40 to 50% was claimed on this improved design.

But the shaikh's endless rope moved over a crude pulley. Two things happened. Weight of rope against pulley squeezed out water. If pulley was revolved very fast, centrifugal force helped throw more droplets of water against a trough, to collect in a container below.

Needless to say, the unhappy victims did a lot of cranking to get a drink of water by that method. And the shaikh always had enough "sinners" on hand from his tribe so they'd fight for the chance to turn the crank, rather than die of thirst. Eventually they wore themselves out with the constant turning. Those who couldn't turn fast enough to satisfy their thirst, when their time at the pump came up, did die.

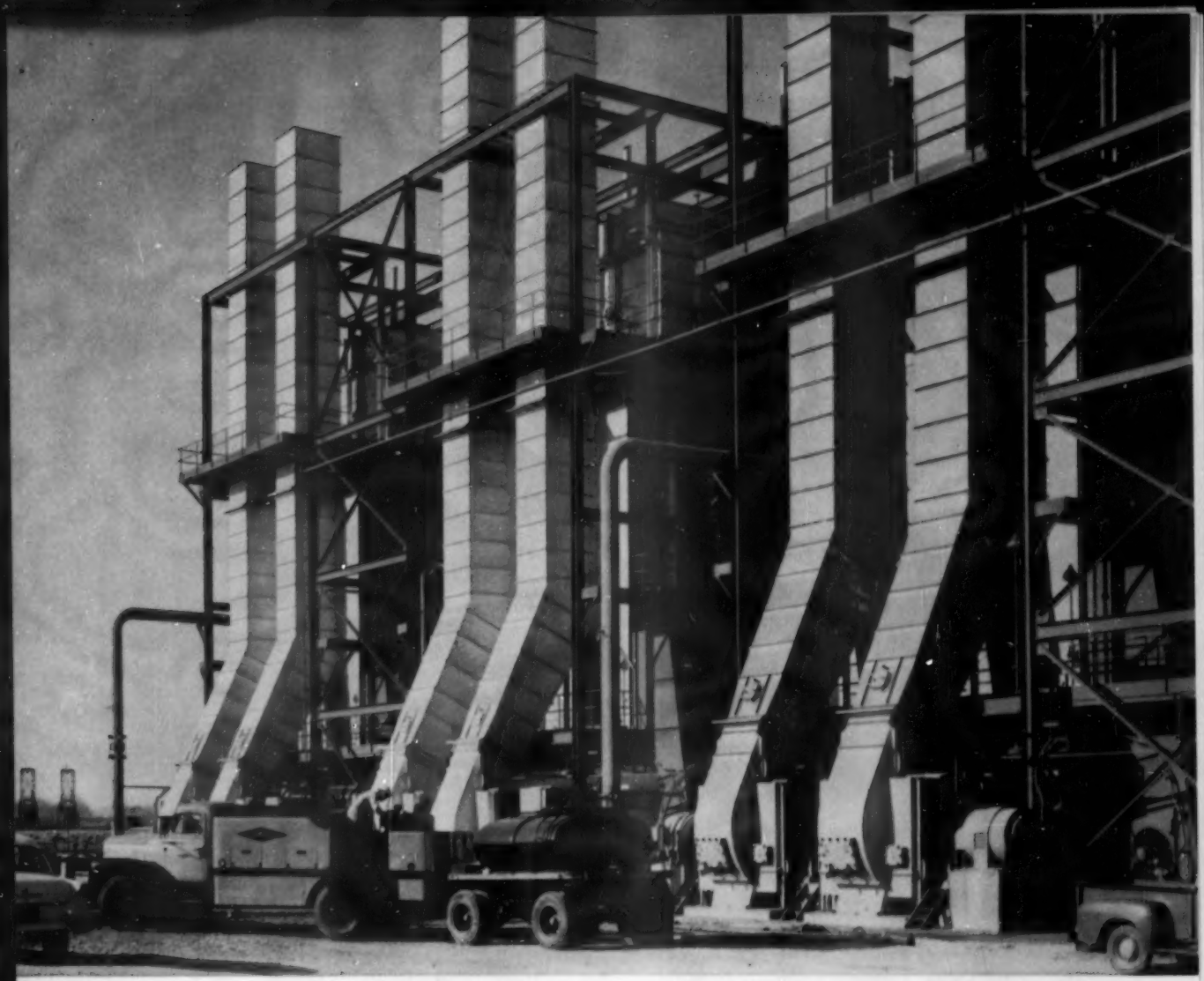
Of course, the unfortunate prisoners could no nothing about their sad plight. But many of us put ourselves in a similar tough spot. For example, we nibble away at important problems, squeezing out tiny droplets of results. Such an attitude wears us out fast, gets us nowhere.

But where there was no escape for the shaikh's prisoners, there is a way out for us. It lies in taking an entirely new approach to our problems. With eyes that are open to what modern equipment and management methods can do, we can cure wasteful practices at one stroke, instead of cranking away year after year, with only droplets to show for our back-breaking toil.

## You can't hide good

Never let an opportunity pass to say a kind and encouraging thing to or about somebody. Praise good work done, regardless of who has done it. If criticism is needed, criticize helpfully, never spitefully.

George Edwards



# BOILER TUBE FAILURES ELIMINATED

## Regular program of DOWELL chemical cleaning for six boilers ended tube failures due to scale

The tubes of a 500,000 pph boiler in a chemical plant contained an extremely hard high-silicate scale up to 1/16-inch thick. Mechanical cleaning was unsatisfactory, because it required a long shutdown and still left hard scale in the tubes.

Dowell engineers formulated a special solvent and quickly removed the scale from the boiler. The operator now has all six of the 500,000 pph boilers on a regular schedule of Dowell chemical cleaning. Since the beginning of this program, the boilers have been cleaned several times and there have been no tube failures caused by scale deposits.

Chemical cleaning is designed to add years of life to your equipment by helping to protect it from over-heating, galvanic attack, and pitting-type corrosion. Downtime is held to a minimum, because solvents are introduced through regular connections . . . extensive dismantling and scaffolding are not needed.

Dowell Service brings you over a decade of experience in the chemical cleaning of many kinds of equipment, including more than 10,000 high- and low-pressure boilers. Contact the nearest Dowell office for more information. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. E-23.

*chemical cleaning service for industry*

DOWELL

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# Here's Why Aeromaster Fans mean more satisfactory cooling equipment operation

Manufacturers and users of cooling equipment agree... Aeromaster Fans give outstanding service. Here are the reasons why.

Aeromaster Fans are *precision engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. And when you consider new equipment, call on Koppers . . . always eager to be of service.

KOPPERS

Aeromaster Fans

METAL PRODUCTS DIV. • KOPPERS COMPANY, INC. • BALTIMORE, MD. • This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators and Gas Apparatus. Engineered Products Sold with Service

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., *Aeromaster Fans,* 265 Scott St., Baltimore 3, Md.
Gentlemen: Please send me detailed information on Aeromaster Fans for

.....
(name and type of equipment to be cooled)

Name.....

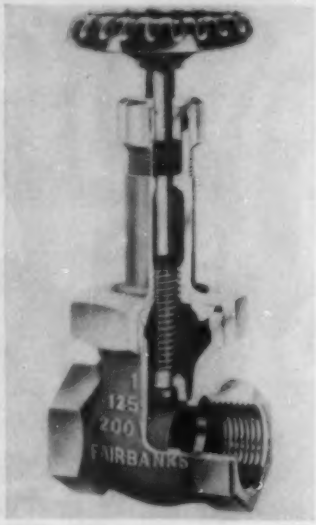
Title..... Company.....

Address.....

City..... Zone..... State.....


# More EQUIPMENT NEWS

Begins on page 158



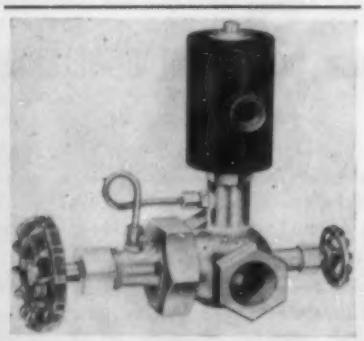

### Union bonnet gate valves

**525** • Union bonnet rising steam gate valves in the 125 and 150-lb steam working pressure classes, replace manufacturers solid and split-wedge rising stem screwed bonnet valves, with same pressure ratings. They are recommended for general service on steam, water, gas or oil lines where full unrestricted flow is desired.

Outstanding construction feature, according to manufacturer, is 2-piece, radial seat, union bonnet. Two-piece construction eliminates sliding, scraping or scoring of mating body and bonnet surfaces during assembly and provides even contact pressure over the mating surfaces. The valves may be repacked under pressure when wide open. Top seat is located above stem thread, out of flow line, protected against deposits and excessive wear. Details on request.

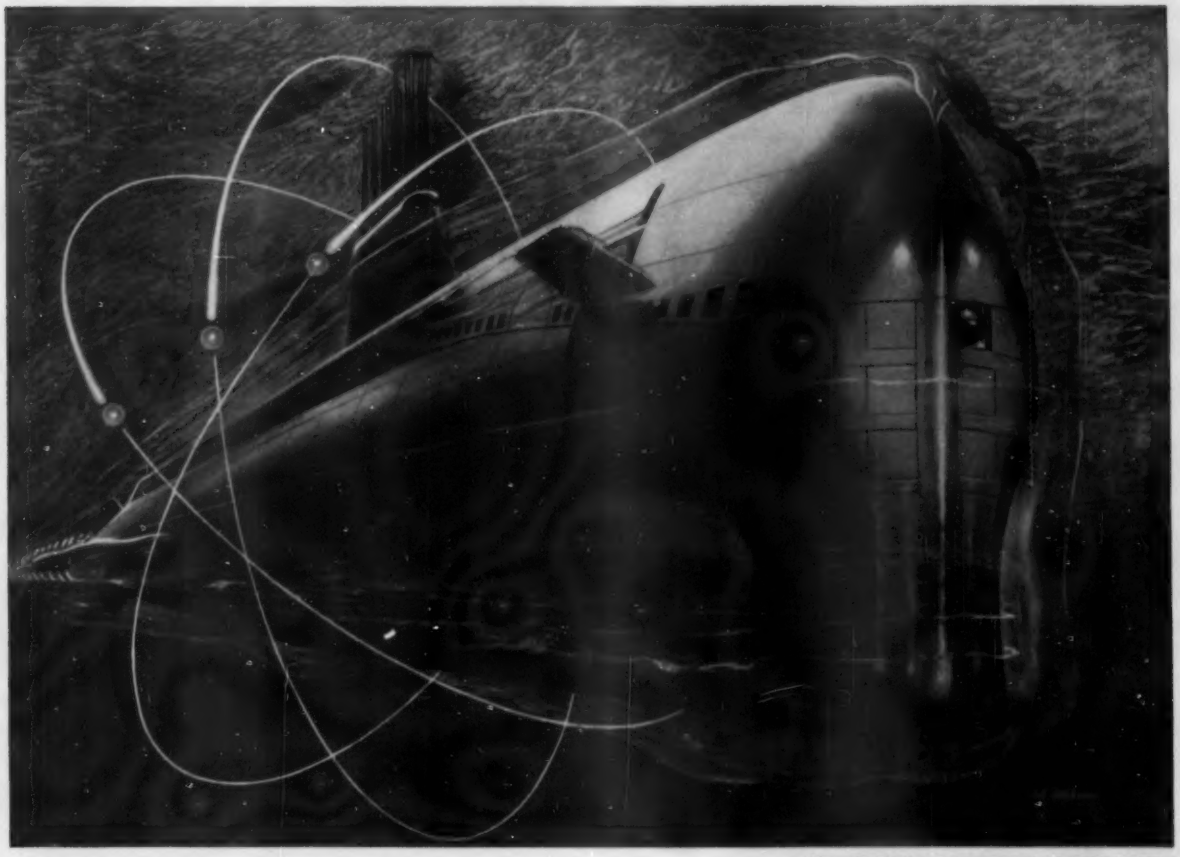
**The Fairbanks Company, 393 Lafayette St, New York 3, N. Y.**

For more data on these items, use post cards p 167. Identify your request with item number.



### Automatic throttle valve

**526** • This valve serves 3 purposes; as a throttle valve, solenoid and check. The check valve operates regardless whether solenoid is energized or deenergized. Valve shown is of bronze, designed for pressures of 300 psi, with renewable disk, 600 psi with renewable disk and nickle seat. It can



# THE "NAUTILUS"

## Atomic Sub and Builders Rely on World's Greatest Lubrication Knowledge

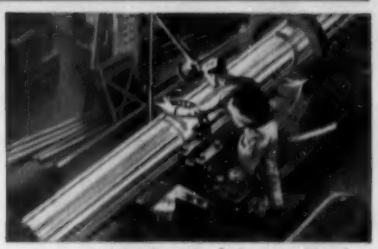
With the launching of the "Nautilus" — world's first atomic-powered submarine — the U.S. Navy crossed the threshold of the atomic age.

Socony-Vacuum is proud that it has been able to play a dual role in this most significant event.

First, famous Socony-Vacuum lubricants are now protecting vital machinery aboard the "Nautilus."

Second, Electric Boat Division, General Dynamics Corp. — builder of the "Nautilus" — relies 100% on our lubricants and a program of Correct Lubrication to protect its plant equipment... has done so for the past 34 years!

We wish the "Nautilus" and her crew all success... pledge our continued cooperation, in every way possible, to the Navy and its suppliers, toward the end of keeping America and her allies strong.



**A snorkel intake tube** being machined to very precise tolerances on one of the large lathes in the Groton plant.

**Hydraulic bender** shapes section of 8-in. steel pipe in two minutes. This operation formerly took a full day.

**SOCONY-VACUUM** *Correct Lubrication*

**FIRST STEP IN CUTTING COSTS**

SOCONY-VACUUM OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

How many years of frictionless service do you get from

# ammonia packing

Chesterton 444, is the most famous of refrigeration packings. Frictionless operation is obtained by means of an oil seal. Elastic backing rings surrounding the bearing-metal alloy rings provide resiliency. As each metallic ring seals on a film of oil, destructive gland pressure is not needed. The metal rings are soft enough to machine themselves to rod or shaft imperfections. The set of 444 rings is made to bend open and slip over the rod or shaft without dismantling the machine. Uninterrupted service of 5 or more years is common on pumps or compressors handling ammonia, freon, $CO_2$, steam, brine, gas or air. The cost is reasonable and delivery prompt. Please send for literature.

PACKING Chesterton SERVICE

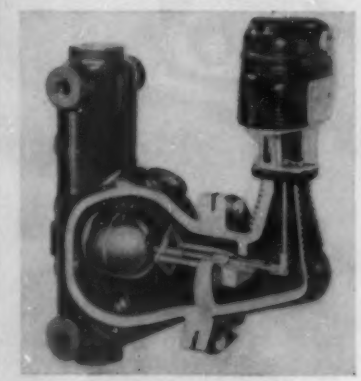
A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings


## More EQUIPMENT NEWS

Begins on page 158

be furnished in ¾ to 3-in. sizes. The same type valve can be made in stainless steel for extremely high temperatures and pressures, in sizes to 10-in.

**Hoppe Engineering Company, Greensboro, Indiana**



### Liquid level control

**535** • Unit is designed primarily for use with boilers up to 250 psi, but is applicable for many other types of liquid level regulation. Basically this is a twin-switch float-operated control. When used for boiler service it can (1) start and stop boiler feed pump as water level in the boiler itself dictates, (2) interrupt current to burner if water in boiler for any reason drops to emergency level, (3) close circuit to alarm if water in boiler drops to emergency level.

Unit employs permanent magnets to open and close the switches used to direct operation from the water level, of the electric boiler feed pump, automatic burner, and alarm system when used. Full details in manufacturer's bulletin L-119.

**McDonnell & Miller Inc, 3500 N Spaulding Ave, Chicago 18, Ill.**

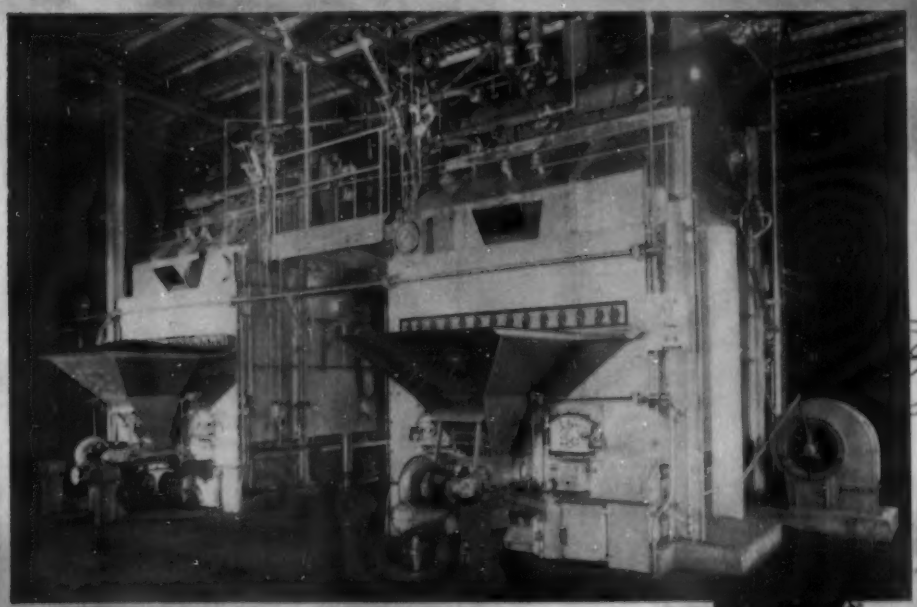
For more data on these items, use post cards p 167. Identify your request with item number.

### Explosion-proof lights

**524** • Stronger body construction of these explosion-proof lights is said to confine any explosions within the system. Notched adapter design provides proper air circulation, assuring cooler and safer operation. Made of light, non-rusting, non-sparking aluminum alloy, these fixtures include: 3 styles, pendant, ceiling and bracket; and 4 sizes, 100 w, 150 w, 200-300-w medium base, and 300-500-w mogul base. Change from

# DETROIT STOKERS HELP REDUCE COST OF STEAM AT PINEHURST

## The Detroit Stoker Equipped Steam Plant at this Famous North Carolina Resort Serves three Hotels, seven other buildings



Steam Plant, Pinehurst, Incorporated, showing Detroit Single Retort Stokers. Boilers are Babcock & Wilcox Integral Furnace Type FF.
John F. Taylor, *Manager Utilities . . .*
Wiley & Wilson, *Consulting Engineers*, Richmond, Va.

The Carolina Hotel, Pinehurst, N. C.—the largest of the three hotels served by this modern plant.

Cost of steam per thousand pounds has been reduced 28½% by the new stoker—boiler installation, according to Mr. John F. Taylor, Utilities Manager, Pinehurst, Incorporated, Pinehurst, N. C. Amount of steam generated per pound of coal has been increased 22%.

The stokers are Detroit Single Retort Underfeed motor driven . . . the boilers are B&W Integral Furnace Type FF. A master regulator is connected to the Detroit Adjustable Feed Control on each stoker and to the adjustable damper of each motor-driven fan to regulate fuel and air in proportion to the load.

Detroit Underfeed Stokers provide high efficiency at low operating cost with small and medium size boilers.

***Write for Bulletins***

**DETROIT STOKER COMPANY**

GENERAL MOTORS BLDG.—DETROIT 2, MICH.
DISTRICT OFFICES IN PRINCIPAL CITIES • WORKS AT MONROE, MICH.

DETROIT SINCE 1898 STOKERS

# *New* WATSON-STILLMAN 150 LB. STAINLESS STEEL PIPE FITTINGS, *Types 304, 316*

Now you can get performance-proved Watson-Stillman Fittings for standard pressure services that need the corrosion resistance, heat resistance and low temperature toughness of 18-8 Stainless Steel.

W-S 150 lb. Stainless Fittings, rated at 400 psi cold non-shock working pressure and 150 psi steam pressure, are ideal for process piping, refrigeration systems, high temperature liquid and gas piping and other piping systems. They are available in both Screw-End and Socket-Welding Types in sizes ¼" to 2".

The new Watson-Stillman Stainless Steel Fittings will assure you of long, trouble-free service in tough piping applications... will reduce down-time and cut maintenance costs. For full technical information on these fittings write today for Bulletin S-3-55.

*Sold Through Leading Distributors*

**WATSON-STILLMAN FITTINGS DIVISION**

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

10


# More EQUIPMENT NEWS

Begins on page 158

100 to 500 w, if need arises, is quick and easy since all fixture sizes fit standardized splice boxes. Details on request to company.

**Killark Electric Mfg Co, Vandeventer & Easton Ave, St Louis, Mo.**

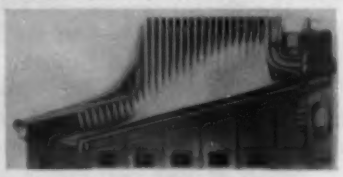
## Full flow oil filters

**537** • Units can be used for filtering a wide variety of liquids including engine lube and fuel oils, metalworking oils and coolants, and parts washing solutions.

Nine different sizes are available using 1 to 36 cartridges. Flow rates range from 25 to 900 gpm. Pressure drop across unit is 4 psi on oil of 170 sus operating viscosity. Resin-impregnated pleated paper cartridge has 44 sq ft of filtering surface. Filter element in cartridge is completely inert and will not remove additives found in many oils. It will not soften or disintegrate when used on coolants or other liquids having a water base. Request bulletin 101.

**Filtration div, Houdaille-Hershey of Indiana, Inc, 98 South Ave, Lebanon, Ind.**

For more data on these items, use post cards p 167. Identify your request with item number.



## Water-cooled stoker

**534** • Advantages of *Vibra-Grate* stoker, according to manufacturer, are freedom from smoke, even at low ratings; elimination of dust collectors; and ready adaptability for burning gas or oil, in combination with coal, or singly.

Fuel is moved by an intermittent vibrating motion imparted to the grate through

# *A 118 Year Old Company Changes its Name*

**AMERICAN LOCOMOTIVE COMPANY is now**

## ALCO PRODUCTS, INCORPORATED

Why this change in a name so widely recognized and long established?

To our many employees and customers —those who know us best—the change is a logical one . . . one that many felt was a long time coming.

Our company has expanded its activities and diversified its products until our former name applied only to a part of our business. It no longer represented our new operations, which have grown beyond our important responsibility as a locomotive supplier.

Look at last year, for example . . .

In 1954, we introduced 18 new products for the chemical, petroleum, power, railroad, and atomic energy markets.

That alone underscores the obvious fact that we are no longer a specialty company but have become one of America's broadly based industrial manufacturers.

So today, this new name has been adopted to reflect the vigorous new company that stands behind it. To our many friends, of course, we have been known for years as "Alco"—now it is official.

And we shall continue to produce traditional "Alco" quality in our new as well as our long-established product lines.

ALCO

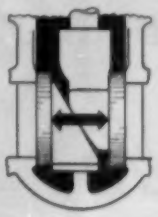
**ALCO PRODUCTS, INCORPORATED**

FORMERLY AMERICAN LOCOMOTIVE COMPANY
New York, N.Y.

*Sales offices* in all principal cities. *Manufacturing plants* in Schenectady, Auburn, and Dunkirk, New York; Latrobe, Pennsylvania; Chicago Heights, Illinois; Cincinnati, Ohio; and Beaumont, Texas. *Sales Representatives* throughout the World

# LESS MAINTENANCE

- Fully revolving discs
- Uniform wear distribution
- Equalized wedging pressure
- Automatic adjustment for body distortion
- Positive closing



## . . . with Darling gate valves on the job!

DARLING *fully revolving double disc parallel seat* gate valves don't need maintenance as often as other valves.

This exclusive Darling design eliminates valve leakage and faulty operation . . . due to body distortion and manhandling. You can always count on Darlings to close easier, to close tight, and to serve longer without attention.

Available in iron body, cast steel, iron body rubber lined, all bronze and special alloys . . . for all kinds of ordinary and special services.

Made with the kind of ends needed for your particular installations. Write for complete information.

**DARLING VALVE & MANUFACTURING CO.**
**Williamsport 8, Pa.**

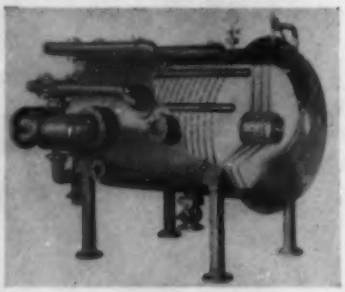
*Manufactured in Canada by*
*Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.*

# More EQUIPMENT NEWS

Begins on page 158

a floating eccentric. Vibrating action levels and auto-compacts entire fuel bed and discharges ash simultaneously. The vibrating grate section forms bottom of the coal hopper and insures constant coal feed regardless of moisture content. Standard capacity ranges from 25,000 to 100,000 lbs of steam per hr are available; with smaller and larger sizes available for special conditions. Details on request.

**American Engineering Company, Aramingo Ave & Cumberland St, Philadelphia 25, Pennsylvania**



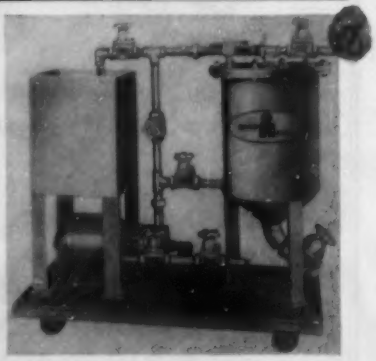
### Diatomite water filter

**527** • Unit is designed to obtain clean pure water from natural sources, such as lakes, rivers, or wells. According to manufacturer, this filter removes 80 to 100% of bacteria, depending on type of bacteria and grade of diatomite used, in addition to all suspended matter either colloidal or solid. Floor space required is only 1/10 that of a sand filter of the same flow capacity.

Economy in operation and cleaning is a claimed feature. Much less water is used to flush off plates with the built-in jet spray and to wash out residue, than is required to backwash most other types of filters. For further information request bulletin 666.

**Sparkler Manufacturing Company, Mundelein, Illinois**

For more data on these items, use post cards p 167. Identify your request with item number.



### Self-cleaning pressure filter

**529** • Unit is designed to remove sludge formed by dissolving electrodes and prevent dust, dirt and oil contamination of metal parts during plating operations.

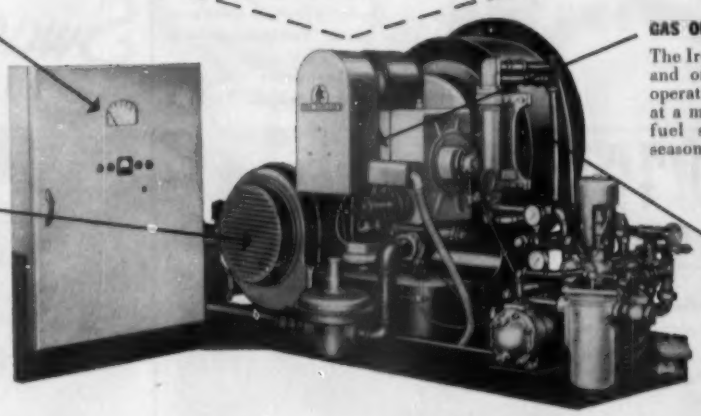
Outstanding features, according to manufacturer, are: new backwashing device that accomplishes filter cleaning by turning two valves; filtration at high pressure (up to

# Modernize your boiler room

## with this dual-fuel firing unit

**AUTOMATIC CONTROLS**
All combustion controls are completely assembled, wired, and tested at the factory. They're fully enclosed in a single control panel for permanent protection from dust and damage.

**FORCED DRAFT SYSTEM**
This forced draft air supply makes possible automatic modulation over a wide range. It is sealed for positive pressure firing and eliminates need for a high stack. Direct-drive construction and low-speed ball-bearing motor assure long trouble-free life.



**GAS OR OIL, OR BOTH**
The Iron Fireman combination gas and oil burner allows switch in operation from one fuel to another at a moment's notice. Overcomes fuel shortage problems; gives seasonal price advantages.

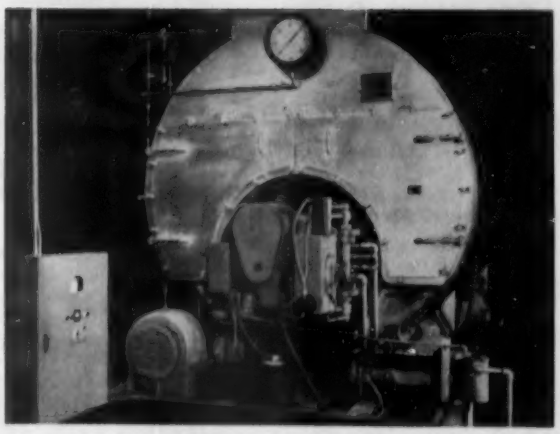
**BUILT-IN REFRACTORY**
The combustion throat, with built-in refractory, is an integral part of burner assembly. Eliminates on-the-job brickwork.

## More than a burner— a complete *PACKAGE* firing system . . .

Iron Fireman package units are much more than conversion burners. They are *complete combustion systems*—with integrated burner (for gas or oil, or both), fuel control system, forced draft air supply, automatic controls, and pre-formed refractory combustion throat.

These firing units are adaptable to practically every type of boiler. Installation consists of little more than attachment to the boiler front, and making electrical and fuel connections. Consequently, installation time costs are sharply reduced from those of any comparable system, assembled in the field.

The Iron Fireman package plan factory-assembles all component parts. It eliminates the divided responsibility of assorted local contracts. And it brings long-range fuel and operating savings, which explain why more and more plants—like that of the Menasha Woodenware Corp. shown here—are switching to Iron Fireman package units.



*Menasha Woodenware Corp., Rockford, Ill., reports their Iron Fireman package unit has lowered fuel costs 6.6% during its first year, with steadier firing and greater cleanliness. Package units are available in a complete range of sizes, as well as the boiler-burner combination shown here. Installation by Allied Heating Engineers, Rockford, Illinois*

It will pay you to get full information on Iron Fireman package burners and boiler-burner units. Just mail the coupon or write.

# Iron Fireman®

**AUTOMATIC FIRING EQUIPMENT FOR OIL, GAS, COAL**
**HEATING, PROCESSING, POWER**

### Send for full information . . .

IRON FIREMAN MANUFACTURING CO.
3044 W. 106th Street, Cleveland 11, Ohio.
In Canada, 80 Ward Street, Toronto, Ontario.
Send information on Iron Fireman package burners.

Name_____

Address_____

City_____ State_____

DO YOU HAVE A TWO-STAGE PRESSURE OR TEMPERATURE CONTROL PROBLEM

MERCOID® HAS THE SOLUTION

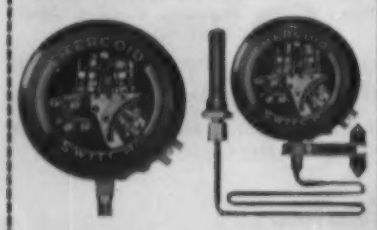
Mercoid DA-400 Series Controls are dual purpose controls (available for pressure or temperature) incorporating a single element operating two separate independently adjustable Mercoid magnetic mercury switches. Circuit arrangements can be supplied for various operations, a few examples are:

*1. Close one alarm circuit at high setting and a separate circuit at low setting. Both circuits remain open between the high and low operating points of the two switches.*

*2. As an electrical interlock to open one circuit on a rise above, and the second circuit on a drop below the set operating point.*

*3. To provide two-stage control by opening one circuit on a rise and a second circuit on a further rise.*

*Pressure types* available in 17 different operating ranges from 0-30" vac. to 300-2500 psi. *Temperature types* available in 11 operating ranges from -30-60°F. to 370-530°F.



All types are equipped with external adjustments and visible calibrated dial.

Our engineers are at your service—send in your control problem or
WRITE FOR BULLETIN CA-PT

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

# More EQUIPMENT NEWS

Begins on page 158

125 psi) without leakage; tank capacities to 5000 gal; and longer filtration cycle made possible by increasing density of the filter cake.

Complete assembly consists of pre-coating tank, splash proof electric motor, pump, filter pressure chamber, valves for suction and discharge flow, and a pressure gage. Assembly can be mounted on a common base and transported to filtration areas anywhere within the plant. Further details in manufacturer's bulletin HH 103.

**U.S. Hoffman Machinery Corp, 105 4th Ave, New York 3, N. Y.**

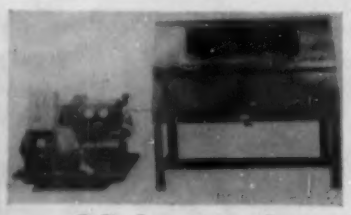
## Unit controls cooling water used on any welding machine

**522** • Unit saves water on all water-using parts of the welder by automatically turning on and shutting off cooling water. Thermostat control stops water flow to electrodes after welder is idle for any length of time. Adjustable by-pass feature allows only enough water to reach ignition contactor and transformer as is necessary to cool these parts sufficiently while welder is idle.

A pilot light at front of *Water Mizer* indicates when cooling water is flowing and also acts as a warning signal in case of trouble. Besides conserving water, unit is claimed to cut down transformer losses due to condensation, reduce excessive mineral deposits in water lines, and decrease sweating, rust and corrosion. Complete details on request to manufacturer.

**Van Vooren Products, 2133 9th St, E Moline, Ill.**

For more data on these items, use post cards p 167. Identify your request with item number.



## Cylinder test stand

**536** • Test stand is used for checking recoil cylinders for tanks. Equipment consists of power unit and test bench with hood and lucite glass for observation.

The power unit delivers oil at 3000 psi, through high pressure hose to cylinders under test. Cylinders are not drained but

*You name the metal or plastic*

WE'LL MAKE THE

Swagelok®

TUBE FITTINGS

EASY TO USE . . . . . .

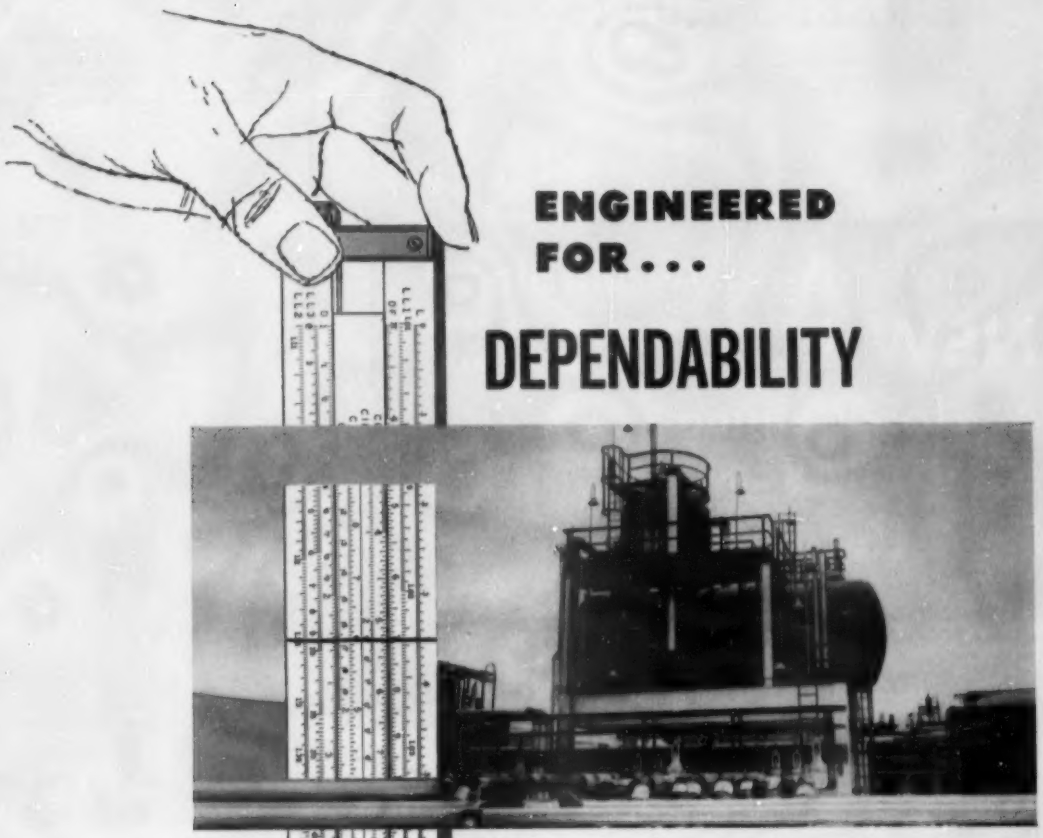
NO SPECIAL TOOLS NEEDED

NO FLARING OR THREADING

From stock or on special order, you can get Swagelok Tube Fittings in any metal you require ranging from titanium to brass — *in fact, any machinable metal or plastic.* When you use Swagelok Tube Fittings every joint is leakproof. No bothersome small leaks to cause shutdowns. Tubing is rigidly supported, thereby avoiding vibration. No torque is transmitted to the tubing. Swagelok Tube Fittings can be used on heavy or thin wall tubing of every tube material, including plastic. Plus the fact that Swagelok joints are easier and faster to make. Get the facts now.

FREE: For complete information write for the Swagelok catalog. Address Dept. E-13.

CRAWFORD FITTING CO.
884 E. 140th Street
Cleveland 10, Ohio



**ENGINEERED FOR...**

# DEPENDABILITY

**GRAVER**

# DEAERATING HEATERS

**SPRAY, TRAY and SPRAY-TRAY...**
**FOR THE POWER PLANT**

**Write for: Articles T-114, T-115, T-117 and T-127**
**Spray Heater Bulletin WC-101A**
**Tray Heater Bulletin WC-106**

*Industrial Department: I-112*

**GRAVER WATER CONDITIONING CO.**
***A Division of Graver Tank & Mfg. Co., Inc.***
**216 West 14th Street, New York 11, N. Y.**

# CHAMPION PIONEERS AGAIN —

in Making Available

## NEW ELECTRODES

for Welding

## CHROME-MOLY

ALLOY STEELS

Champion now brings to the fabricator of Chrome-Moly Steels a new type of low hydrogen electrode of the AWS xx15 type, excellent for all position welding.

Champion's Croloy Electrodes produce a weld deposit with a carefully controlled composition which almost completely eliminates weld cracking and greatly reduces the preheat necessary as well as relieving the necessity of maintenance of preheat prior to stress relieving.

Champion Croloy Electrodes produce very smooth weld deposits in all positions and pass the most rigid X-ray requirements. Weld deposits from Croloy Electrodes possess very high ductility, 20-26% in the as-welded condition, and 24-30% stress relieved at 1350°F, as well as show stress-to-rupture properties equal to or exceeding that of the plate material. Champion Croloy Electrodes 3/32" through 3/16" diameters are available in grades for welding .5% Cr, .5% Mo through 5% Cr, .5% Mo material.

***Complete technical data on Champion Croloy Electrodes will be furnished upon your letterhead request. Write Now! Dept. P.***

THE CHAMPION RIVET COMPANY

CLEVELAND 5, OHIO — EAST CHICAGO, INDIANA


# More EQUIPMENT NEWS

Begins on page 158

left full of oil. Five units can be tested individually before it is necessary to refill the power unit. Details on request.

**J N Fauver Company Inc, 51 W Hancock Ave, Detroit 1, Mich.**

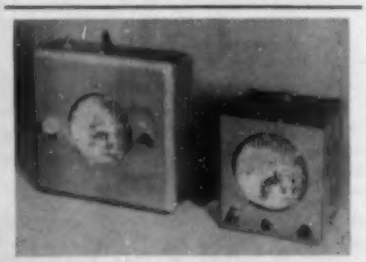
### Dehumidifier-filter

**539** • *Vi-Speed* dehumidifier-filter for compressed air systems is designed with a maximum capacity of 5 scfm at 100 psig. Operating range is from 60 to 150 psig.

Manufacturer states that by removing all contaminants, including oil and water vapors, the *Vi-Speed* assures efficient operation of the instruments or other low volume pneumatic equipment, and reduces maintenance. The pure, vaporless air also increases life expectancy of all pneumatic equipment. Descriptive bulletin available on request to manufacturer.

**Van Products Co, 5776 Old Ridge Rd, Swanville, Erie 7, Pa.**

For more data on these items, use post cards p 167. Identify your request with item number.



### Emergency safety lights

**533** • *Safeguard Lites* are designed to supply light by battery power when electricity fails. As soon as electric current stops,

# POWERFUL GUY!

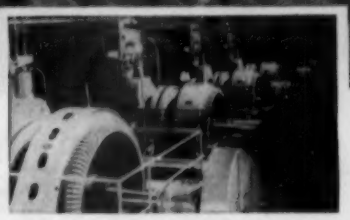
**His four Nordberg Diesels, lubricated by Cities Service DC-940 Oil, supply six Oklahoma Counties with REA power. Have one of lowest cost-per-KWH records of entire REA.**

His name's H. P. Wingo, and he's Chief Engineer of the REA plant operated by Western Farmers Electric Cooperative.

For the past four years, since his plant began operation in Woodward, Oklahoma, he's been responsible for a consistently high power efficiency rating, measured in cost per kilowatt hour...as high as fifth among all 42 REA plants! To maintain this record, he's had important help... help from four 1100 KW Nordberg dual-fuel engines...and help from Cities Service DC-940 Oil.

"Our engine compressions are the same today as they were after the first three months' operation," says Wingo. "In addition, using Cities Service DC-940, rings have remained absolutely free, liners have worn less than .0015, and we average 14,000 horsepower hours per gallon of oil. Filter elements last up to 1,500 hours."

Wingo has added his words of praise to those of scores of other users of Cities Service Lubricants. Summed up, these reports clearly demonstrate that superior performance is not the exception, but the rule, with Cities Service products. Your Cities Service Lubrication Engineer can readily explain why. Talk it over with him. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.



4 NORDBERGS, 4 YEARS OLD... yet engine compression remains the same as after first three months of operation at Western Electric REA Plant, Woodward, Okla. Rings "absolutely free," liners worn less than .0015, oil consumption at 14,000 H.P. hrs. per gallon using Cities Service DC-940 Oil.

CLOSE CHECK is kept on entire operation. Meanwhile, Cities Service Lubrication checks wear in Nordberg engines, helps engineer Wingo maintain record of low cost electricity. Supplying economical power to six Oklahoma Counties, plant's power efficiency rating has been as high as 5th in entire REA.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

# Fresh Viewpoint on Dust Collection!

After seeing the daily operating records kept on Buell 'SF' Electric Precipitators and Cyclones by our customers . . . many executives and engineers have come away with a fresh viewpoint on industrial dust collection.

They have balanced initial cost against *actual* day-to-day results . . . they have investigated maintenance costs over as much as a 20 year period . . . they have compared designs with efficiency *maintained* over the years.

We invite you to look these daily operating records over yourself . . . there's Buell Equipment operating from Pennsylvania to Peru and a Buell Customer near you. We'll be glad to give you his name.

Meanwhile, get the complete facts about all three Buell Systems for industrial dust recovery. Our clearly worded Brochure—The Collection and Recovery of Industrial Dusts—will give you the whole story fast. Simply write Dept. 50-E, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

buell®

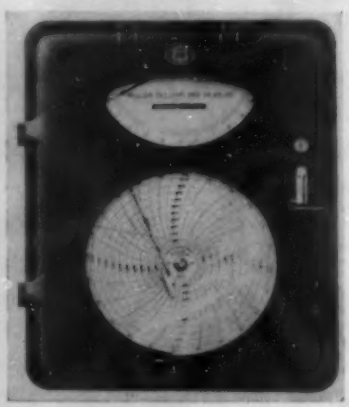
MECHANICAL ELECTRICAL *20 Years of Engineered Efficiency in* DUST COLLECTION SYSTEMS

## More EQUIPMENT NEWS

Begins on page 158

battery power of the units is automatically turned on. Compact and lightweight, they are handy emergency lights and also serve as searchlights when not plugged into the electrical current. Equipped with battery test buttons and 6-v sealed beam lamps.

**Jamil, Inc, PO Box 717, Winter Park, Florida**



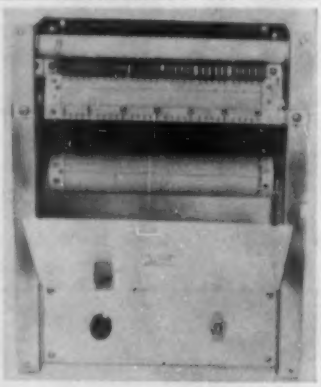
### Electric transmission system

**523** • Instrument is designed for installation where accurate transmission of flow or other measurable data is required over distances and where it is not possible to obtain data through use of mechanical measuring devices. It can be adapted to transmit data over private wires in in-plant services or, with addition of a few simple parts, for use over leased telephone channels.

Transmitting units may be applied to mercury cylinders of varying sizes to produce measurements over 4:1, 10:1, 13:1, 18.5:1 and 20:1 ratios with accuracies not exceeding ±2% at any point over these ranges. Complete information on request.

**Simplex Valve & Meter Company, 7 E Orange St, Lancaster, Pa.**

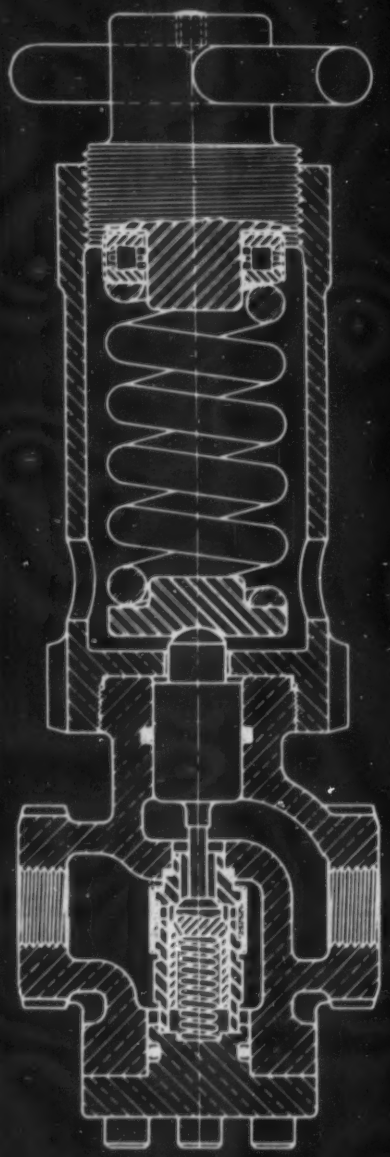
For more data on these items, use post cards p 167. Identify your request with item number.



### Inkless recording unit

**550** • Multi-channel recorder is designed to instantly record time, sequence and duration of as many as 30 events on one chart. No ink, typeribbon or moving pens are used. Record is made on electro-sensitive paper, making it possible to record

# A RUGGED, DEPENDABLE VALVE FOR HIGH-PRESSURE APPLICATIONS



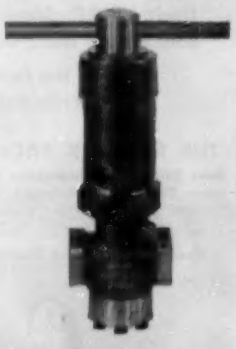
## CASH STANDARD

### TYPE 345

### Pressure Reducing and Regulating Valve

**Designed for hydraulic presses, hydraulic systems, die-mold apparatus and high pressure pneumatic systems (oxygen, nitrogen, hydrogen).**

- For use on air, water, oil and various gases (not for steam)
- Inlet pressures: 500 to 4000 psig
- Delivery pressures: 400 to 3000 psig
- Bronze or steel construction
- Piston-operated with O-ring seals
- T-bar adjusting screw combined with roller thrust bearing for ease of adjustment
- Internal strainer screen
- Corrosion resistant
- Operating fluid around renewal unit results in equal expansion and contraction of internal mechanism, precludes sticking or seizing
- Easily serviced without removal from line
- Renewable inner units of nitrided or stainless steel. For severe conditions, stellite facing is available
- Screwed ends, sizes ½", ¾", 1"



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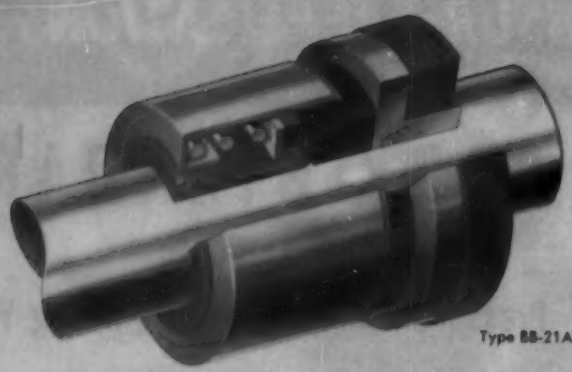
**CASH** C S **STANDARD**

A. W. CASH COMPANY • P.O. BOX 551, DECATUR, ILL.

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

# GARLOCK MECHANIPAK SEAL



Type BB-21A

## for Rotating Pump Shafts at pressures up to 150 p.s.i.

MAY IS NATIONAL WATER SYSTEMS MONTH

The Garlock BB-21A MECHANIPAK Seal, proven in service on thousands of water pumps, provides a low cost *leakless* seal.

**IMPORTANT FEATURES**

This MECHANIPAK Seal occupies a very small space—specifically designed for rotary pump shafts. It comes completely assembled, ready to install. Standard construction includes brass shell, brass washer and Buna-N bellows. Other materials available. Furnished for shafts from ⅝" to 3" diameters.

**SAVE 3 WAYS**

Customers tell us the MECHANIPAK Seal *pays for itself.* (1) Reduces maintenance costs (2) Absolutely no shaft wear (3) Cuts down time.

Get all the facts on this MECHANIPAK Seal. Write today for bulletin AD-150.

**THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.**

Sales Offices and Warehouses: Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Los Angeles, New Orleans, New York City, Palmyra (N. Y.), Philadelphia, Pittsburgh, Portland (Oregon), Salt Lake City, San Francisco, St. Louis, Seattle, Spokane, Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ontario

# GARLOCK

PACKINGS, GASKETS, OIL SEALS

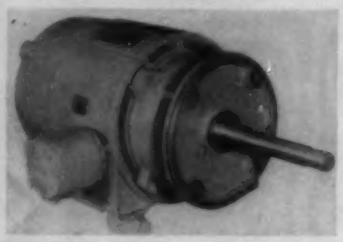
MECHANICAL SEALS, RUBBER EXPANSION JOINTS


# More EQUIPMENT NEWS

Begins on page 158

instantly, without mechanical lag. No drying, developing or other processing is required. Request bulletin RO-2670.

**Larson Instrument Company, 24 Orchard St. Tarrytown, N. Y.**



### Close-coupled pump motor

**519** • Totally-enclosed explosion-proof motors are designed for use with centrifugal pumps operating in dangerous, damp or dusty locations. They are available in 1½ to 25-hp models.

Special features, according to manufacturer, include: face type registered mounting bracket for accurate shaft alignment and simplified pump mounting; precision ground shaft for accurate pump impeller mounting; and solid flange and brass slinger for complete liquid deflection. Larger ratings are double-enclosed and fan ventilated for rapid heat dissipation. Smaller ratings are self-cooled by radiation.

**U.S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, California**

For more data on these items, use post cards p 167. Identify your request with item number.

### Arc welding system

**546** • New system of arc welding is claimed to reduce to a minimum the need for preheating and heat treatment subsequent to welding. Specifically intended for welding chromium-moly steels used in equipment for high pressure-high temperature services, this system employs a group of chromium-moly electrodes, called *Croloy*. Weld deposits of *Croloy* are said to exhibit unusual stress-rupture characteristics over a wide range of temperatures, along with outstanding ductilities and resistance to corrosion and oxidation.

Important applications, according to manufacturer, include welding of power piping, fabrication of high pressure boilers, petroleum refinery equipment and chemical processing plant equipment.

**Metal & Thermit Corp, 100 E 42nd St, New York 17, New York**

### Fire extinguishers

**551** • Unit functions at temperatures of -65 F, and has special rubber hose to withstand extreme cold without stiffening or cracking. Nitrogen is used to expel dry chemical extinguishing agent.

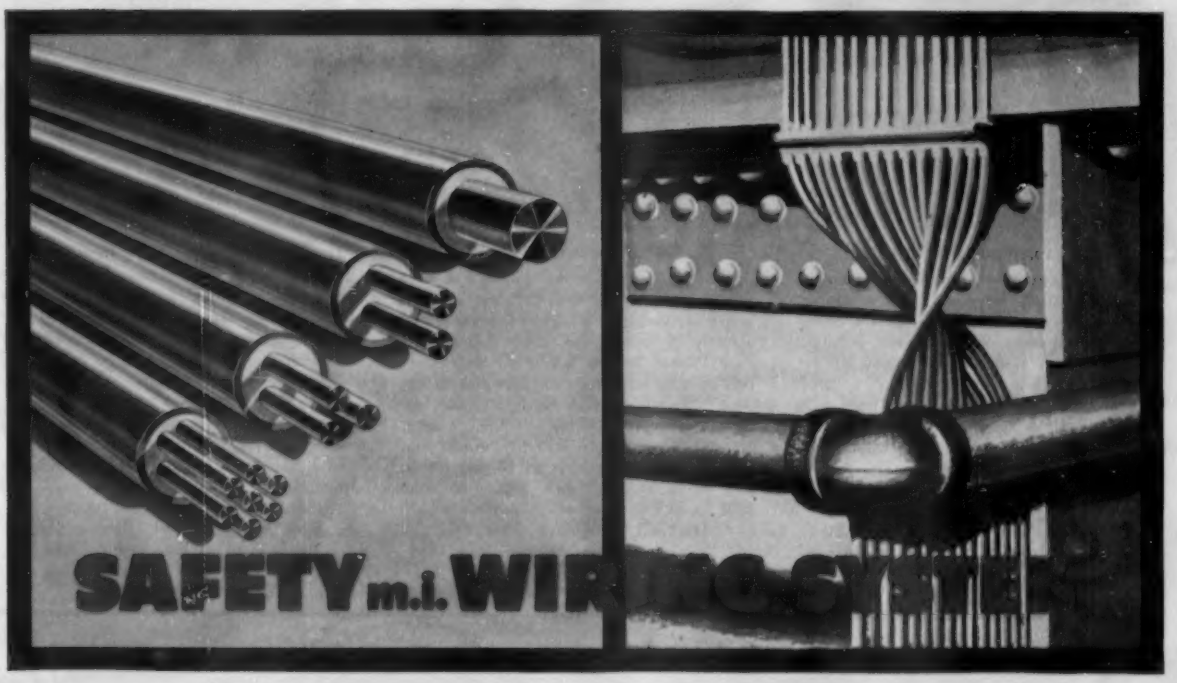
Hand portable units are available in 4- and 20-lb capacities; wheeled units in 150- and 350-lb capacities. Details on request.

**Ansul Chemical Co, Marinette, Wis.**

(*More Equipment News on p* 188)

GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE



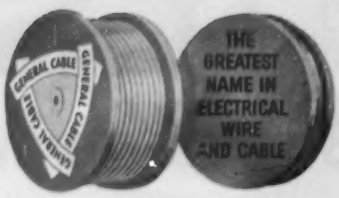

**A dramatic new advance** in electrical wiring for all applications up to 600 volts and wherever heat, vapors, moisture and aging are problems. Safety m.i. Wiring is ideal for low voltage, lighting, power, control, machine tool and equipment uses.

The mineral insulation of Safety m.i. Wiring is physically stable up to 2800° Centigrade . . . will not burn, deteriorate, support combustion, or convey flame . . . provides extra safety in boiler rooms, around steam pipes, boiler stacks and other "hot spots." Simple fittings seal both ends of wiring runs . . . no possible entrance for moisture.

**Underwriters' Approved** Safety (Type m.i.) Wiring Systems offers lower installation and maintenance costs. Acts as its own conduit . . . can be installed in one operation with standard switch and junction boxes. Easily shaped on the job, Safety m.i. can be fastened with standard clamps or straps . . . stays put permanently!

**Save time and money! Get a neater job! Simplify planning!** Ask your General Cable Representative for all the facts about Safety m.i. Wiring Systems. Remember, too, General Cable is the *only* manufacturer who can supply *all* your wire and cable needs!

**GENERAL CABLE**
**CORPORATION**

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**GENERAL CABLE CORPORATION**
*Executive Offices:* 420 Lexington Ave., New York 17, N. Y.

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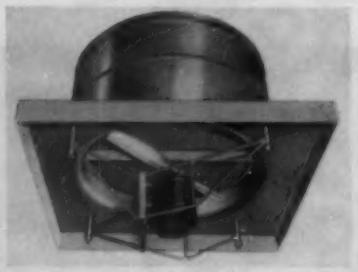
# More EQUIPMENT NEWS

**Direct-current voltmeters**

**518** • Dc expanded scale voltmeters for panel mounting are claimed accurate to ½% of input voltage. Unit offers a linear scale that includes only the useful portion; the rest has been eliminated to give highest readability.

Standard base voltages range from 6.25 to 230 v, with span that can vary from 4 to 25% of base voltage. Available in 2½ and 3½-in. round or square, 4½-in. round, and 4 x 6-in. rectangular models.

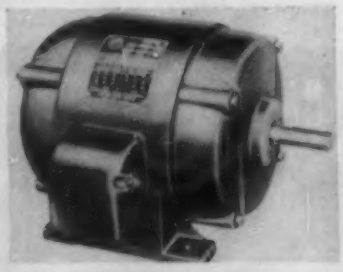
**Arga division, Beckman Instruments, Inc, 220 Pasadena Ave, S Pasadena, Calif.**



**Roof ventilators**

**552** • Unit consists of galvanized steel windband mounted over a curb base of heavy galvanized steel. Fan mount is bolted directly to base, with inner diameter in base formed into a fan ring. Galvanized lids in windband turn on plastic bearings —opening when fan is on, closing weather-tight when it goes off. When lids are open, air stream effectively prevents entrance of rain or snow. Available in 18, 24, 32, 36 and 42-in. models, with capacities from 3000 to 26,400 cfm.

**Hartzell Propeller Fan Co, Piqua, Ohio**



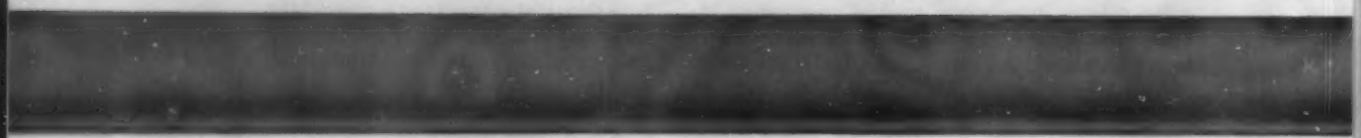
**Industrial electric motors**

**530** • These smaller frame motors provide greater hp in a smaller package—efficiency is greatly increased with reduction in unit weight, manufacturer states. Lower air opening in end-bell combined with steel baffle plate is said to give maximum protection to winding from moisture and abrasive dusts. Double-end ventilation is provided by dual cast aluminum fans.

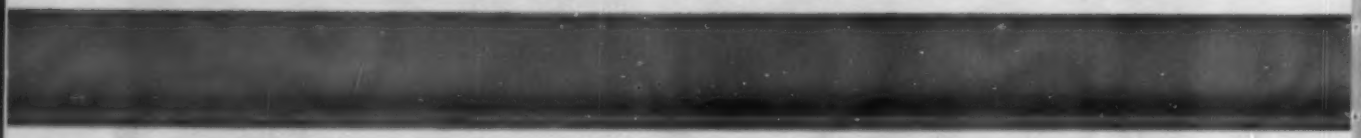
All standard ratings are available in frame sizes 182, 184, 213 and 215. Full details on request to manufacturer.

**The Lima Electric Motor Co, 164 Findlay Rd, Lima, Ohio**

**Bridgeport Brass can now supply plain**



**up to 75 ft in length . . . available in**



**operating conditions. Be sure to inquire**

Begins on page 158

### Multiple torque converter

**520** • Fluid torque multiplier for gasoline or electric motors under 10 hp is said to boost power 2.8 times. Unit is claimed to eliminate shock starting or stopping and gives full, easy power take-offs on intermittent or power loading. Called *Fluomatic* it is available as a standard package unit or with custom modifications.

Manufacturer states that test results have proved excellent on garden tractors, screw conveyors, winches, hoisting devices, oil well equipment and numerous other machines. Unit consists of a turbine, reaction member and pump in an aluminum housing. Total weight is 27½ lbs. Full details on request.

**Little Beaver Industries, Willoughby, Ohio**

For more data on these items, use post cards p 167. Identify your request with item number.

### Xenon filled thyratrons

**542** • Two Xenon filled thyratrons having identical electrical characteristics, have been developed for use in motor control and ignitor firing circuits. The *EL C4J* is designed for socket mounting; the *EL C4J/F* for panel mounting wherever conventional sockets might not be desirable.

Ratings of both models are 4-amps dc continuous average anode current; 30 amps oscillograph peak current with maximum peak forward and peak inverse of 900 v. Average arc drop is 12 v and heating time is 60 seconds. Descriptive data sheet available on request to manufacturer.

**Electrons, Inc, 127 Sussex Ave, Newark 3, New Jersey**

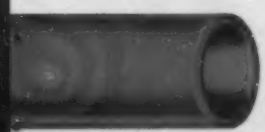
### Gear reduction units

**531** • Standard stock gear reduction units are available in 52 models (283 different units) with ratios from 5:1 to 3600:1 and output torque ratings from 40 to 9400 in. lbs. Compact design and improved worm gearing is claimed to provide greater load carrying capacity with less weight and less space. Fins on housings improve heat dissipation. Details on request.

**Boston Gear Works, 104 Hayward St, Quincy 71, Massachusetts**


and dual-gage extra-long condenser tubes

standard Bridgeport alloys to meet your



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**ENGINEERED FOR OUTSTANDING PERFORMANCE IN MANY OPERATIONS!**

On board ship, in refineries, hospitals, public utilities—in paper, textile and all general industry, the Coffin line of turbo equipment is earning nation-wide acceptance for outstanding performance. Designed with versatility in mind, latest addition to the line the Coffin "DE" Turbo Pump has a Volumetric Range to 800 GPM, Discharge Pressures to 1500 psi, Steam Temperatures to 850° F., Exhaust Pressures to 80 psig, and Liquid Temperatures to 325° F. Ratings can be exceeded in special installations.

Engineers! Write today for complete specifications. Ask for "DE" Bulletin G-110.

THE J. S. COFFIN, JR. COMPANY
326 South Dean Street, Englewood, New Jersey
Cable Address: COFCO
Representatives in the United States, Canada, Europe and the Far East


## MARMADUKE

Continued from page 146

was rolling along at high speed, shipping was tough. My ship paid off and tied up in a Brooklyn bone yard after arriving from Australia in ballast. With thousands of seamen on the beach around the East coast, I grabbed a boxcar for Orangeburg, N. Y. There, my old friend Lewis Van Huben was chief of the Rockland State Hospital plant and I knew he would give me a break until I got the wrinkles out of my belly.

"When I dropped into the large hospital plant," continued Marmy in his foghorn voice, "Lewis and his boys were trying to light off a boiler. The place was filled with smoke and everyone was hustling around, coughing and trying to find out the cause.

"The boiler giving all the trouble had a 204-foot, round brick chimney. But distance from breeching outlet to top of stack was all that counted, and that was about 176 feet.

"That boiler was an 835-hp Stirling-type watertube job, operating at 150 psi. As I remember it, stokers were retort underfeed cascade type with rear dump. Combustion control was fully automatic, with draft from a forced-draft fan. At that time they burned run-of-mine bituminous coal.

"We stepped over to the windward side of the boiler room and shook hands. Lewis told me the boiler and its tall chimney had been out of service for about a month. They tried to light it off that morning—only it wouldn't light off. For some reason they couldn't get draft above the fire in the uptakes, or chimney.

"We went back to the boiler where his boys were still checking. All the dampers were opening OK and the automatic controls were working according to Hoyle. Fan was running normally and there was plenty of air up to the grates. But above the grates—no dice. All they could get was positive pressure. And that blew coal, ash and smoke out through the furnace doors and through the furnace openings.

"Lewis had his boys check the breeching. There wasn't any soot or flyash to worry about. Draft through cleanout doors didn't amount to much. This all looked interesting, so I kept my trap shut.

"One of the boys came running back from the office yelling that the log showed they forgot to clean the stack's base during lay-up — hadn't been cleaned for over a year. That was a clew and every clew was grabbed at. Distance from stack's bottom to breeching was 36 feet, but Lewis had them check it for being plugged anyway.

"They organized a maintenance gang, but found the soot well below the

ONE MORE REASON TO CHOOSE PRITCHARD COOLING TOWERS:

# EVERY MEMBER IS WORKING HARDER NOW— YOU SAVE ALL THE WAY DOWN THE LINE!

That's why the new Pritchard cooling tower framework design means savings to you. The new design utilizes materials to the fullest possible extent. As an example, each diagonal member is used in both tension and compression. Result . . . a stronger, more efficient structure.

What does this mean to you? It means that Pritchard towers now offer you the following new advantages:

- Elimination of excess framework members reduces material and freight costs.
- Installation is faster and easier. You save on field labor costs.
- Basin cost is far less. Simplified design requires anchoring only around the periphery of the tower. Inside the basin, it is no longer necessary to build post-supporting piers — post extensions can be provided at far less cost.
- A Pritchard tower is now even easier to maintain . . . there are fewer connections to check.

Pritchard tower framework has always been completely pre-fabricated on precision machines for perfect fit. Now, new Pritchard design adds new efficiency, new economy. One *more* reason to choose Pritchard cooling towers!

INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
AIR COOLED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

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OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 429, 4625 Roanoke Parkway, Kansas City 12, Mo.

new!

Get your complimentary copy of the new Pritchard brochure, "Answers to the 15 Questions About Pritchard Induced Draft Cooling Towers." Fascinating reading to anyone interested in learning more about cooling towers. Your copy awaits — write for it today on your company letterhead.

The raised ring around the circumference of one end of the Pritchard connector casting matches the ring groove in the framework member. Thus, stress or strain is never on the bolt, but is evenly distributed over the entire area of the ring.

## Choose WESTERN
## for Chemical Treatment of Water, Steam and Fuel

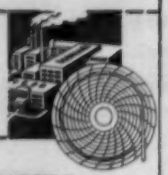
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

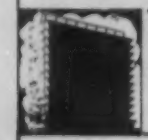
**1** *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

**CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.**

**2** WESTERN BOILER FEED WATER TREATMENT

**Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.**





**3** COOLING WATER TREATMENT AND ALGAECIDE

**Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.**

**4** BRINE AND SWEET WATER TREATMENT

**Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.**

**5** WESTO HOT WATER TREATMENT

**Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.**

**6** WESTERN LIGHTNING TREATMENT

**Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.**

**7** WESTERN ALUMINA NO. 45

**Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.**

**8** WESTERN SOOT REMOVER

**Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.**

**9** WESTERN FUEL OIL SLUDGE DISPERSANT

**Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.**

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# MARMADUKE

Continued from page 190

breeching. That's when everyone started scratching his head. With the large blower pushing air under the coal bed, and the high stack clear, why no draft?

"There seemed to be only one answer and Van Huben got busy. He checked back over the weather records. Then it came out that during the lay-up period, the weather was the wettest in years. And, for good measure, temperatures during that time were very low for June and July, while the humidity had been way up.

" 'My theory,' said Lewis Van Huben, 'is that all that rain landing inside the idle chimney soaked the layers of soot deposit. Because the dampers on that boiler were tightly closed, air in the chimney and breeching is cooler and heavier than outside air. Add to this the natural vaporization of moisture in the soot at chimney's base and you have a column of air too heavy to be easily displaced by the fan. So the little heat from struggling starting-fire doesn't count.

" 'Hold everything,' I barged in, 'Here's my theory, boys, and I'll prove it. Most engineers think that damp air is heavier than dry air—but that's so much bilgewater. When you displace a cubic foot of dry air with moist air at sea level, the dry air that's displaced is heavier than the moist air. That's because the moisture, which is a very low-pressure steam, isn't *added* to the volume of dry air, it *displaces* dry air. Look at your steam tables and see what saturated steam at 70 F weighs compared with dry air at 70 F.

" 'Only thing to do here is build a wood fire in the stack's base. Right now that 70-F air in the stack is too heavy for the fan to raise. It weighs 176 ft times 0.075 lb per cu ft, or 13.2 lb. Bring up the stack-air temperature with a wood fire to 300 F and the fan only has to work against 176 times 0.052 lb per cu ft, or 9.2 lb. Besides that'll give you a chimney effect and you won't have a draft problem.'

"Last time I saw Van Huben," wound up Marmy, ballasting his settlers from another bottle of San Miguel beer, "he told me that after every lay-up period since, they start a drying-out fire in the stack's base. And they haven't had trouble with the draft in over 23 years, even after the wettest lay-up period."

—*SME*

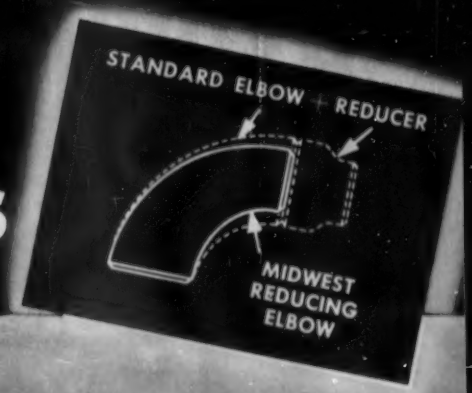
EDITOR'S NOTE: Have you run into this kind of trouble? If so, why don't you write me the details?—*SME*

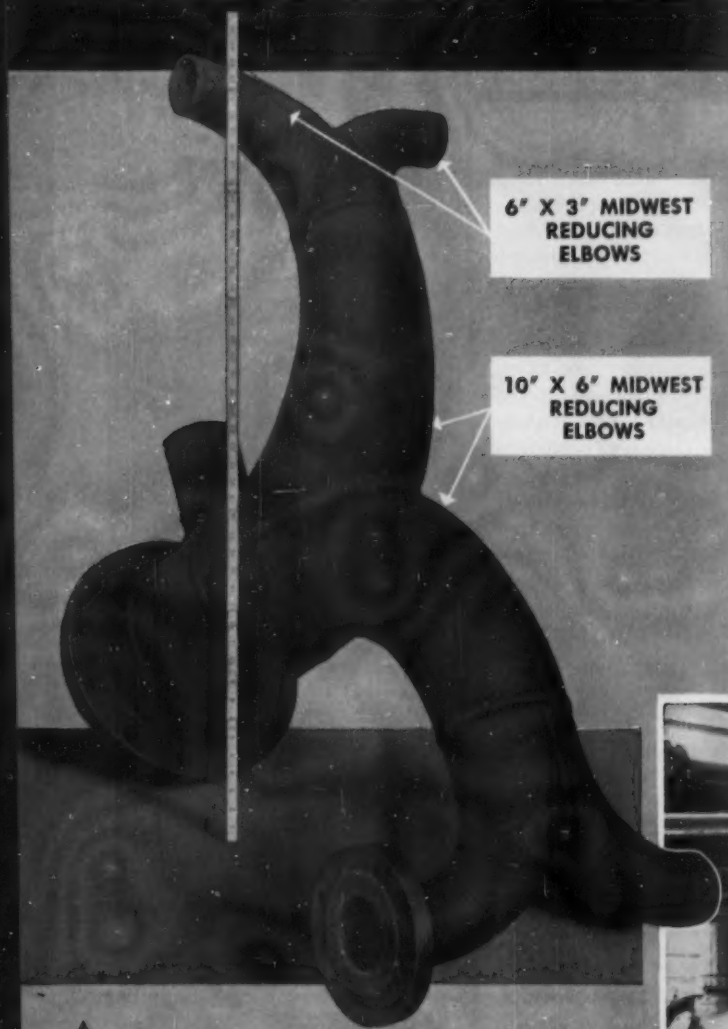
### Marmy's Mailbox

After reading Marmy for some time, I wonder if the Sandpaper Gin he drinks is the square-bottle variety with the

# *Better Piping at a Better Price*

## *by Using* MIDWEST REDUCING ELBOWS



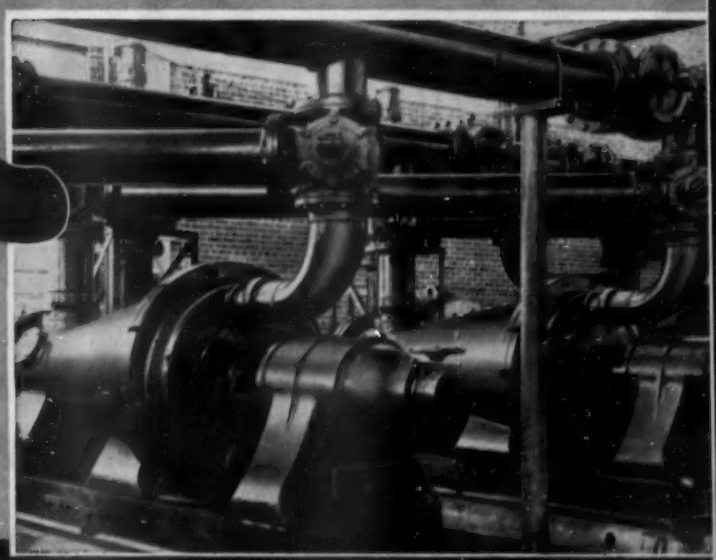




The Midwest Reducing Elbow offers important advantages in both piping design and piping cost. It needs only two welds instead of the three required by a standard elbow and a reducer (see sketch above). There is also a saving in layout time. Turbulence and pressure drop are reduced by the gradual taper . . . less space is needed . . . insulation is easier . . . and piping appearance is improved.

Only Midwest Reducing Elbows are available from stock in sizes to 16" . . . larger on special order. They have the same dimensional accuracy, uniformity of wall thickness, exact included angle and true center-to-end dimensions of Midwest Straight Elbows. For further information, ask for Catalog 54.

6991

Midwest Reducing Elbows made it possible to fabricate this transformation piece for a boiler feed suction line so that it could be installed in the limited space available and still get the benefit of streamline flow. There was also a cost saving in comparison with a less efficient and bulky assembly made with straight tees, ells and reducers.



Paper stock flows with minimum resistance through Midwest Reducing Elbows from 8" connection on Jordan to 10" header. Other advantages over standard elbow and reducer: a saving in cost and space, and improved appearance.

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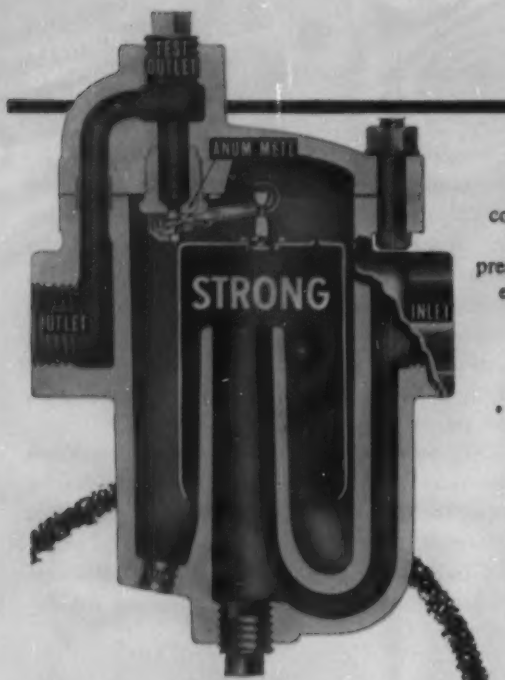


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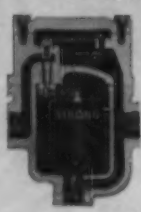

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Thermal types for quick air and condensate removal during rapid heating up.

**STRONG STRAINERS**
Offer maximum protection from dirt, scale or sediment. Available in semi steel, cast steel and bronze.


## MARMADUKE

*Continued from page 192*

locomotive on it that we used to get in Manila, or the stuff in tin cans we got in Shanghai? We used up all the fruit juice cutting that stuff down one night aboard ship, then tried cutting up a head of cabbage to flavor it. It was terrible, don't ever let the old boy try it. It's something like Aleutian Solution. By the way, Pisco, Silvowitz, etc, fall on deaf ears here. They don't mean anything to these landlubbers, who have never been past Minneapolis or possibly Watertown.

S KRONE *Canby, Minn.*

I read Marmy's yarns quite a bit and enjoy them—in fact I have a backlog of his stories since they started in *Operating Engineer.*

L W FITZPATRICK *Jefferson City, Mo.*

Of the 84 Marmaduke stories I have read to date, I especially enjoyed two—in one he raised the wooden mast with the help of two cobras and in the other he split all those old Civil War cannon balls.

I didn't quite believe his explanation of why his triple-expansion engine stopped on dead center in heavy weather at sea. I had that experience, but in my case the engine took a slug of water. That stopped it and put an offset in the piston rod. The offset jammed in the stuffing-box gland and the old engine stopped.

A F SHEEHAN *Springfield, Mass.*

I'm still laughing after reading about Marmy taking off his pants, for SCIENCE. That story made the rounds of our office and we all feel that the old boy really put his point over.

ED ECKERT *New York, N. Y.*

We always enjoy reading Marmy's adventures here at Yarnall-Waring Co. He gets involved in some interesting situations. The old boy does an excellent job of weaving pointed words of caution and advice into an interesting yarn.

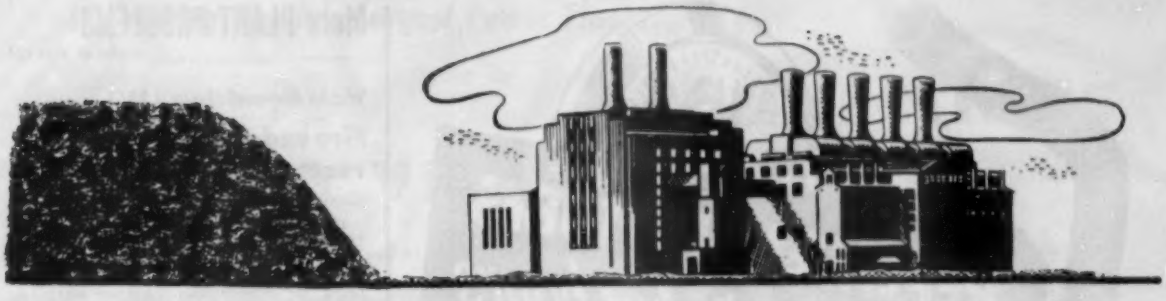
I'm going to circulate my copy of his book to our people in Sales and Engineering. I'm sure they'll get a chuckle out of his yarns.

BILL MILLER *Philadelphia, Pa.*

I want POWER to know how much we at Linear, Inc, enjoyed the book, *The Marmaduke Story.*

Marmy is certainly an ingenious, if undegreed, engineer. It's nice to know that the horse in the church steeple really did help solve that refrigeration problem.

E J PARKER *Philadelphia, Pa.*



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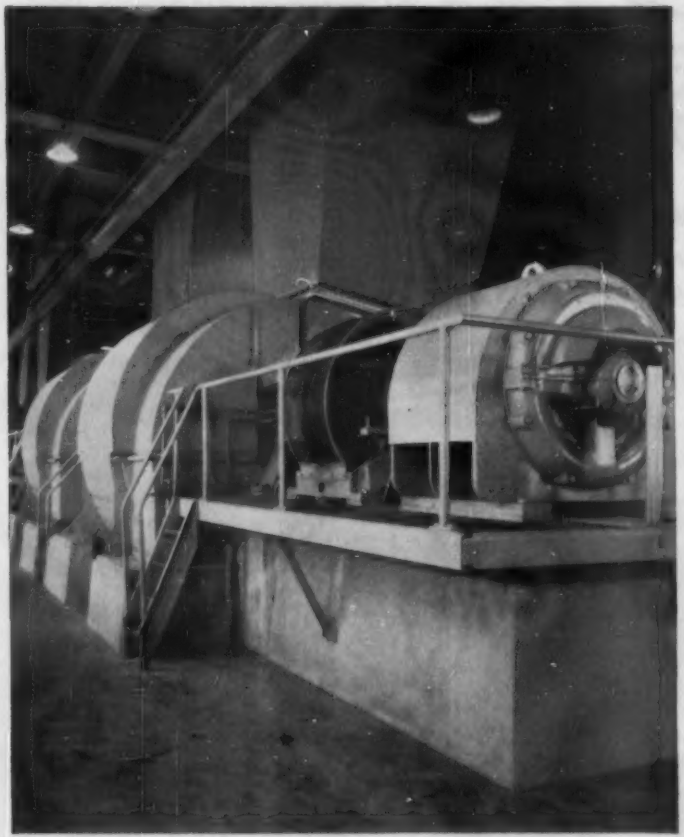

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2


## More PLANT PROBLEMS

Begins on page 134

**Waste disposal (from p 135)**

### Fire underwriters' recommendations

CONSTRUCTION should be in line with standards of the National Board of Fire Underwriters. They recommend at least an 8-inch thickness of clay or shale brick for combustion-chamber walls, to be erected with structural steel for bracing. Inside, this shell is lined with at least 4½ inches of firebrick. Greater thickness is necessary where incinerators are operated continuously at high temperatures. And the entire structure should permit expansion and contraction of the brick and lining.

A J BREUGELMANS *New York, N.Y.*

**Other readers** sending good answers on waste disposal, for which we lacked space, are:

| | |
|---|---|
| E J ANDERSON | *Cleveland, Ohio* |
| C G HOWARTER | *Canton, Ill.* |
| H RASMUSSEN | *Crystal Lake, Ill.* |
| W J STEINERT | *Flushing, N. Y.* |
| J W SMITHWICK | *Washington, D. C.* |

**Boiler schedule (from p 138)**

### Inspect boiler at different loads

TODAY'S TREND is to operate boilers as long as the insurance company permits. A carefully worked-out inspection schedule—at different loads—will tell *EC's* engineer how his boiler is operating. Here are points to check:

- Boiler-feed pumps, water supply
- Stoker and stoker drives
- Pressure or draft loss in ducts
- Draft gages
- Overfire conditions
- Furnace walls, for slag build-up or erosion (look through inspection ports)
- Weekly water analysis. Switch to daily, if water isn't OK
- Daily fuel consumption

C G HOWARTER *Canton, Ill.*

### Frequent shutdown can cause headaches

MANY TROUBLES can be traced to effects of start-up and shut-down. Just a few of the problems that can come up are unequal heating of boiler surfaces, stresses in tubes and piping, corrosion of metal surfaces when gas and corrosive ash reach their dewpoint temperature.

Alternate heating and cooling cycles also lead to refractory troubles, since condensed combustion gas can destroy

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In power plants such as Cutler near Miami, which by midsummer 1955 will have 380,000 kilowatts capacity, and in substations throughout the state CADWELD connections help FP&L speed its gigantic $410,000,000 construction program.

For in fabulous Florida—where industry finds a business climate as favorable as the natural climate—power engineers have found CADWELD connections are best because:

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2—They cannot loosen or corrode.

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CADWELDED . . . this #2/0 stranded copper cable ground wire to 69 KV steel structure.

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## More PLANT PROBLEMS

Begins on page 134

refractory brick and mortar. These factors, plus insurance savings, make 6-month operation a wise move.

H B WAYNE *Brooklyn, N. Y.*

**OTHER READERS** sending good answers on boiler scheduling, for which we lacked space, are:

| | |
|---|---|
| A Verstoep | Williamsport, Pa. |
| A C Veen | New York, N. Y. |
| R C Conk | Newark, N. J. |
| F Liceni | Buenos Aires, Arg. |
| W M Huff | Chamois, Mo. |
| R Graefen | Chicago, Ill. |
| J W Smithwick | Washington, D. C. |
| A A Hunnewinkel | Woodstock, Ill. |
| R J Anderson | New Brighton, Minn. |
| S H Krone | Canby, Minn. |

## RADIATION SHIELDING

Continued from page 96

*bine-Generator Units*, by C W Elston and P H Knowlton. The turbine was assumed to be a 3600-rpm tandem-compound triple-exhaust unit. The feedwater system was assumed to have cascaded drains and internal drain coolers in heaters with outlet terminal differences of 5 F. Energy input to the water by the feed pump was neglected. The turbine produces 155,000-kw output.

To figure sodium flow we note the 400-F temperature rise and an average specific heat of 0.306 Btu per lb per F. Then sodium flow equals:

$$\frac{400{,}000 \times 3413}{400 \times 0.306} = 11{,}130{,}000 \text{ lb per hr}$$

Similarly for the NaK flow we have also a 400-F rise and a specific heat of 0.251 Btu per lb per F. Then NaK flow equals:

$$\frac{400{,}000 \times 3413}{400 \times 0.251} = 13{,}500{,}000 \text{ lb per hr}$$

Next let us look at the auxiliary-power needs:

1. Reactor, liquid-metal systems and associated auxiliaries = 7500 kw
2. Steam - cycle auxiliaries (feed pumps, circulators, etc) = 4500 kw
3. Total plant auxiliary demand = 7500 + 4500 = 12,000 kw

Net station output then equals 155,000–12,000 = 143,000 kw. This gives us an over-all station thermal efficiency of 100x143,000/400,000 = 35.7%.

Each nuclear cycle must be analyzed on its own merits. These technical data, of course, are not the whole story, costs must be taken into account also.

*Next part of the study course will cover site problems and rules for making economic studies—in a forthcoming issue.*

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FOR EXAMPLE: A $10,000 annual saving was made possible when this battery of four 80 hp. *Powermaster* Packaged Automatic Boilers replaced a 200 hp. coal-fired boiler in a large Mid-West plant of a prominent electrical manufacturer. The *Powermasters* eliminated a smoke nuisance . . . coal and ash handling . . . and labor costs for firemen. Improved steam pressure and quality, and operating flexibility were other advantages gained.

Savings start with *Powermaster's* simplified installation whether single or multiple units. No special foundation or costly stack is needed. As delivered, *Powermasters* are fully equipped, completely wired and factory fire-tested for fast operation as soon as fuel, water, electrical and steam connections are made. Other cost-saving advantages are high fuel economy at all loads, space-saving compactness, dependability, maintenance-saving accessibility, fully automatic operating and safety controls, smokeless combustion and hospital-clean boiler room.

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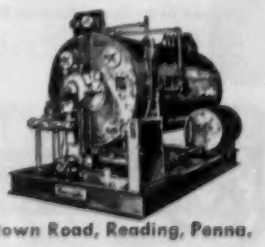

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**On Inside Duct Lining**—A ¾" thick layer of Super #3000 over the insulation provides long-life refractory lining that withstands erosion of hot abrasive gases.

**On Boiler Tubes**—By painting the tubes in the passes of the boiler with a thin mix of Super #3000, considerable protection is provided against erosion.

There are a great many more reports of Super #3000 success—where other refractory mortars have failed quickly and utterly—in boiler walls and arches, coke oven floors, furnace linings, etc.

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## ATOMIC PLANT

Continued from page 81

in conventional steam separators. Nonradioactive steam leaves the drum at 420 psia. All surfaces in contact with the corrosive primary coolant water are stainless steel. Auxiliaries for the steam generators maintain the 1500-psia pressure, fill and drain the equipment, purify the coolant water, dissipate reactor heat after shutdown, handle fuel elements, seal glands.

Each of the four boilers and their auxiliaries will be housed in a large horizontal steel container. These vent to the vertical vessel housing the reactor core. These vessels are enclosed in a thick, dense concrete shield. Top of the vessel containing the fuel elements will be removed periodically to replace spent fuel elements with fresh ones. All refueling operations must be done remotely. On the other hand, the boilers, valves and pumps will be accessible for inspection or repair shortly after shutting down the reactor.

Spent fuel elements will be stored in a deep water-filled tank next to the reactor. After a storage period, the spent fuel elements will be shipped in thick-walled lead containers to Government processing plants for recovering the unburned fraction of the fuel.

**Incremental economy.** A separate oil-fired superheater raises steam temperature to 1000 F; pressure at turbine throttle will be 370 psia. These steam conditions allow using a standard-type steam turbine of 236-mw capacity. The reactor produces 140 mw of capacity and superheating, 96 mw. Over-all heat rate of the station is expected to be about 10,700 Btu per net kwhr. The 96 mw produced by superheating is obtained at a very favorable incremental heat rate and cost.

## More ARGUMENTS

Begins on page 140

steam pressure were under the seat, valve would close like a check valve and keep feedwater out of the boiler.

Many operators and plant engineers say that the valve cannot be packed without shutting down when the feedwater enters under the disk. Perhaps a graphic description of a few dry boilers caused by a detached feed-valve disk would convince them that the valve should be installed correctly.

E D Dow Jr *Barberton, Ohio*

### Suggests another way to put boiler on line

I ENJOYED Harry M Spring's article, "You can prevent boiler accidents" (February POWER). But to coin a

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

# Preferred for Precision and Performance

FIG. 19084—900-Pound Steel Pressure Seal Non-Return Globe Valve, Gear Operated.

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And there are other good reasons why engineers prefer Powell Valves—because Powell Valves are dependable . . . economical . . . and Powell has the COMPLETE quality line of valves.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have.

**The Wm. Powell Company**
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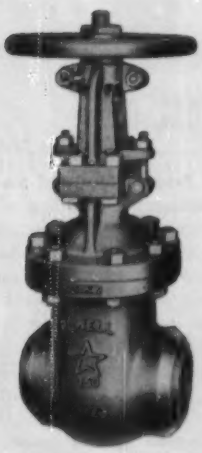

FIG. 1503WE—150-Pound Steel Gate Valve.

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

FIG. 19003—900-Pound Steel Pressure Seal Gate Valve.

# POWELL VALVES

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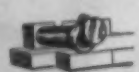

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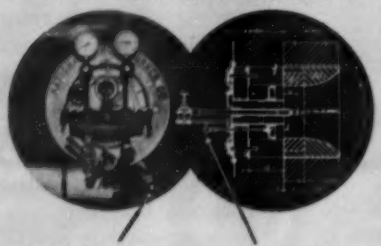
### NATIONAL AIROIL
**UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS**



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

### NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT


## More ARGUMENTS

Begins on page 140

phrase, "BILGEWATER on his way of putting a boiler on the line."

I prefer to let the stop-check valve do the work. Open stop-check and header valve even before there is steam in the boiler. Make sure line between stop-check and main header valve is well-drained of condensate.

Then, when boiler is up to pressure, stop-check lifts automatically, and unit is on the line. This method is safer than the one Spring suggested.

B H COKER *Lompoc, Calif.*

### Water flow in boiler may reverse

HERE'S ANOTHER SOLUTION to the problem of why water leaves the gage glass, December "Plant Problems."

Front-end circulation in many fire-tube boilers is restricted by spacing of the tubes. Water flow reverses when boiler is steaming violently.

Assume that two hours after start-up, water in the boiler is hot enough to cause violent steaming. Level shown in the gage glass would then drop because of flow reversal. Naturally, I assume that the drop in level had not been previously observed. It occurs only once a day and the level was probably restored by the feedwater regulator to make it visible in the gage.

Any condition where water does not show in the gage must be considered dangerous. Possible corrections are to carry the water level higher at start-up or to install a water gage having a longer visible glass.

W A FASSBENDER *Philadelphia, Pa.*

## COAL DUST

Continued from page 80

**Proportioner and pump** stand in the car-dumper building a short distance from the car-dumper sprays. These need the greatest solution flows only during short periods while dumping cars. The unit also stands close to the sprays on the pan feeders below. Distance to most remote spray point, the Bradford breaker discharge, is about 300 ft.

The proportioner includes a tank built in two 200-gal sections. One stores the concentrated wetting compound and the other the solution. An ejector type unit and controls proportion automatically the supply compound to the water flow. Water comes from the raw-water house service supply and passes through a dual-type fine strainer and the proportioning unit to the solution tank. A level-control valve in the water-supply line maintains the proper level in the tank. The level-control unit maintains

# STEEL FORGINGS by MESTA

custom made to your mechanical and metallurgical specifications

Y's

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PIPE

VALVE BODIES

LATERALS

CROSSES

ELLS

Chrome Molybdenum Alloy Steel Y's forged, machined, rigidly inspected and tested to comply with customer and code specifications. Mesta Forged Fittings and Pipe provide confident service in High Pressure and High Temperature Piping Systems.

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Electric Steel and Open Hearth Furnaces
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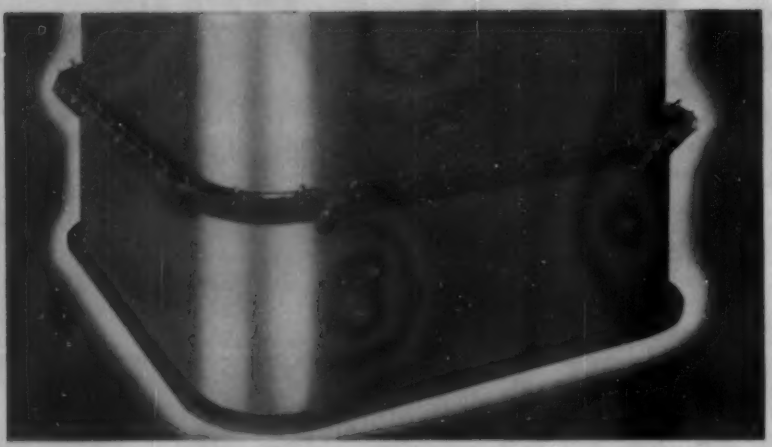
Chemical • Metallurgical • Physical Laboratories
Complete Testing Equipment

ROLLING MILLS • ROLLS • FORGINGS • HEAVY DUTY TOOLS

**MESTA MACHINE COMPANY**

PITTSBURGH, PENNSYLVANIA

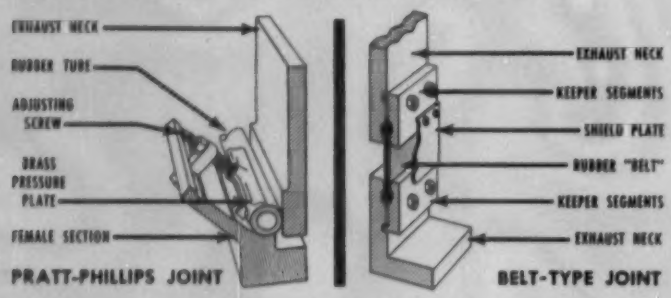


*simple-flexible*

# TURBINE-CONDENSER EXPANSION-JOINTS

**Pratt-Phillips joint is ideal flexible connection.** Absolutely air-tight under vacuum and steam-tight under exhaust conditions, it is easily installed and sets up no undue strains in the turbine casing.

**Rubber element provides flexibility in all directions.** The rubber sealing member is held under compression by pressure plates. Protected from oil and sunlight, it lasts for many years. The exclusive Pratt-Phillips design exposes only one-twelfth of the rubber surface to steam.




**Easy to install or replace.** The rubber element can be installed, removed or replaced in less than three hours on even the largest joints. No special rubber shapes are required; the same type is used on round or rectangular stacks.

**Other types of joints available.** For installations where space is limited, the belt-type expansion joint is advantageous since it requires no more space than the exhaust stack itself.

**The Henry Pratt Company offers complete engineering and manufacturing facilities for exhaust stacks and joints, flues, ducts, butterfly valves and other power plant equipment.**

**Our engineers can help with your problems...write for full details.**

HENRY PRATT

**POWER INDUSTRY EQUIPMENT**

TURBINE-CONDENSER

Expansion Joints

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill.

## COAL DUST

Continued from page 202

a supply of compound at practically constant level and insures accurate proportioning once the proportioning unit has been adjusted regardless of level change in the compound storage tank. The wetting compound comes in 55-gal drums. A portable air-pressure-operated barrel drainer transfers the compound from the drum to the storage tank. A turbine-type electric-motor-driven pump draws solution from the tank and pumps it into a common header under pressure for supplying the entire system. A relief valve in the discharge line recirculates some of the solution depending on spraying requirements. A float switch in the solution tank shuts off the pump if the level drops below a set point.

**Operation.** The solution pump may be started by a local switch or one in the car-dumper operator's cab. Another switch in the cab also turns the car-dumper sprays on or off. Operating personnel may turn sprays on or off at other locations by local switches. After being turned on, the sprays run automatically, needing very little attention. Any one or more of the sprays may be used for allaying dust. This depends on the initial moisture in the coal.

The car-dumper sprays are somewhat exposed to the weather because of opening the large doors at each end of the building. We can run these sprays during the winter except during short periods of extremely cold weather when they freeze up. The exposed headers may be drained when not used. Albany station has electric heating cable and insulation to prevent freezing. Other spray points are in heated areas.

**Costs.** The capital cost of the equipment, erection, engineering, design, supervision, piping, wiring and installation labor was about $15,000 for the Dunkirk setup. Operating cost, consisting mainly of wetting compound, water, electricity for the pump, runs little less than 1½c per ton of coal. Part of the time the coal has enough moisture as received not to require spraying.

Maintenance of the equipment has been practically negligible. The work mainly consists of occasional cleaning of strainers and nozzles.

**Results.** The systems at both stations are very satisfactory and effectively control dust throughout the coal-handling system. Housekeeping is made easier and better. Operating and maintenance men, including bulldozer and carryall operators on the storage pile, work freely without the discomforts and hazards of dusty conditions. Most important, possibility of fire and explosion is reduced to a minimum.

# Unloading 1200-TON BARGES

## in less than 90 minutes

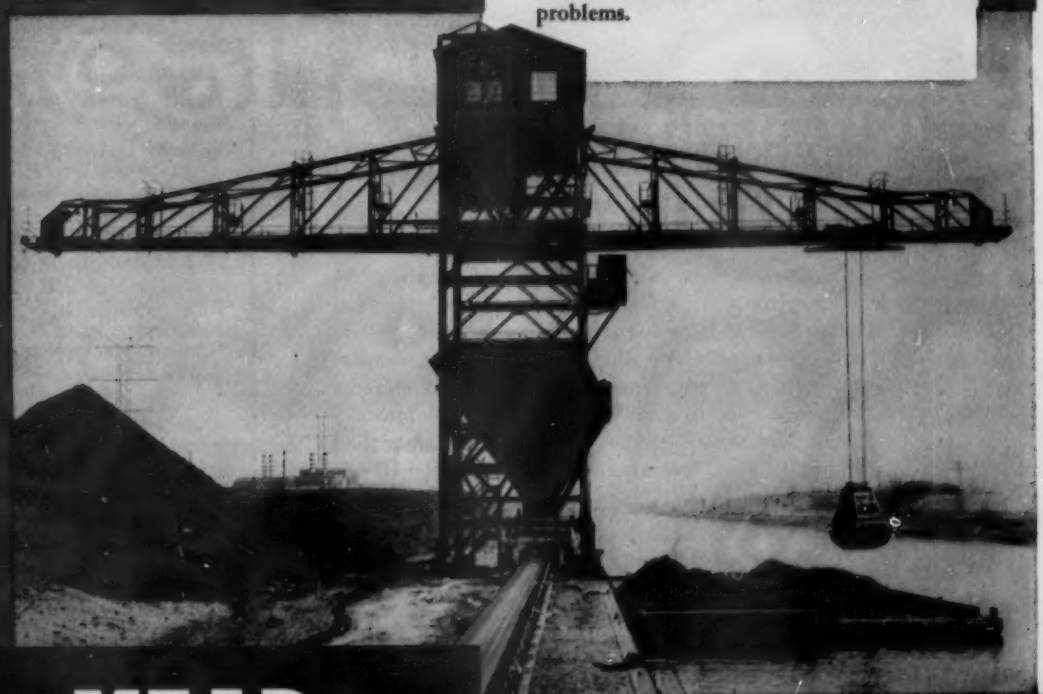
(including clean-up)

This new Mead-Morrison 10-ton stationary coal tower, recently installed at Commonwealth Edison Company's Ridgeland Station, was designed for a free digging rate in excess of 1200 tons per hour from barge to hopper.

The use of a Mead-Morrison lightweight coal grab and a Mead-Morrison barge haul system contributes to this outstanding performance.

One of the features of this machine is an extended cantilever at the rear, allowing coal to be put in storage and to be reclaimed from storage to conveyer belt or barge. Power to the hoist drums is supplied by wound-rotor motors and counter-torque, full-magnetic, reversing, alternating current control for 4160 volts.

Mead-Morrison Coal and Ore Handling Bridges and Unloading Towers are available in capacities up to 2000 tons per hour. They have proven their efficiency and dependability for over 50 years in installations all over the world. Be sure to consult Mead-Morrison on your material unloading and rehandling problems.



**MEAD-MORRISON**

Division of

McKIERNAN-TERRY CORPORATION

acids . . . gases . . . hot liquids . . .
**SOLVE YOUR SPECIAL PACKING PROBLEMS..**

*for* **CORROSION-FREE PACKING SERVICE IN PUMPS AND VALVES....**

You can effectively handle any corrosive liquid or gas by repacking your valves and pumps with "John Crane" Chemlon "C-V" Rings. Molded from the remarkable material, Teflon, "John Crane" Chemlon "C-V" Rings are impervious to almost every known chemical substance. They withstand extreme temperatures from −94° to +482°F—have extremely low friction coefficient. "Breakout" friction is only slightly higher than that of running friction. Special cross sectional design affords positive sealing at practically finger-tight gland pressure.

To bring you all the important advantages of Teflon for your particular sealing problem or application, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.

*"John Crane's" illustrated booklet "The Best in Teflon" contains extensive information on a wide variety of Chemlon Products. Send for your free copy. Crane Packing Co., 1835 Cuyler Ave., Chicago 13, Ill.*
*In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.*

*DuPont's trademark

JOHN CRANE CRANE PACKING COMPANY

## BOILER OPERATION

Continued from page 93

you may have to kill the fires. With a stoker-fired unit where fire cannot be quickly extinguished, this may prove embarrassing.

If water is excessively low, out of sight in the gage glass, and you do not know for sure that level is only slightly below the glass, best procedure is to kill the fires. Should water level drop so low that boiler-pressure parts become overheated, a serious explosion may result if you add water then.

If you kill the fires and do not add water, there may not be an explosion, but boiler must be carefully inspected before refiring. In a stoker-fired unit, if you lose feedwater supply with no possibility of immediate resumption, you may have to remove draft and quench with fire-hose streams.

Usually, water delivery to boiler drops because of loss of feedwater supply or of feed-pump driving power. Discharge head produced is less than boiler pressure. Steam pressure may back up to pump discharge valve so that discharge pressure looks almost up to normal. Then you may not realize that feedwater supply has failed.

If feedwater and steam flow are recorded, you can see why boiler-water level has departed from normal. Proper corrective action may be possible.

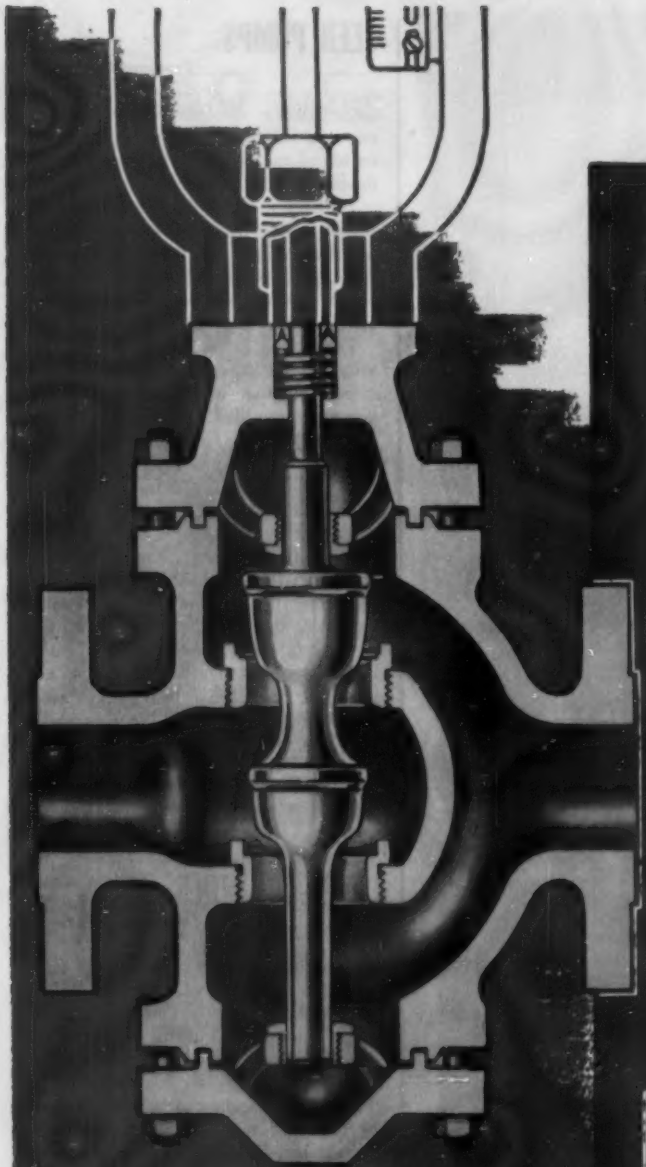
Another cause of trouble: Feedwater-regulating valves may fail to function, allowing water to depart from normal level. In this case, prompt transfer to manual control or to bypass operation may avoid serious trouble.

If boiler-water level is out of sight, the safest course is to kill the fires, shut off feedwater, let the boiler cool and thoroughly inspect it for damage before firing up again.

**Boiler-water conditioning.** Feedwater quality is almost as important as quantity. Troubles caused by deposits on heating surfaces or by priming and carryover from the boiler may come on more slowly than those caused by excessively high or low levels. But they may still occur. A more complete discussion of this subject will follow in another article in this series.

In brief, however, water fed to a boiler should be clean, soft and quite free from silica. Chemicals must be added to prevent scale deposits. Low-solids concentrations have to be maintained to prevent carryover. Test daily to assure that desirable conditions are maintained.

Use the test results to determine (1) feed rate for various treatment chemicals, and (2) amount of boiler blowdown required to hold dissolved solids concentration within desired limits.



Insures superior control with tighter shut-off on high temperature service. Both upper and lower seating surfaces contact simultaneously at specified operating temperatures.

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IS THE VALVE MANUFACTURER THAT LAPS THE SEATS OF DOUBLE PORTED VALVE BODIES AT OPERATING TEMPERATURES

Fisher valve being steam heated to specified operating temperature.

Inner valve being "ground in" while assembly is hot.

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DARTS ARE THRIFTY ON THE POCKETBOOK

. . . TIGHT ON THE LINE!

Yes sir, Dart Unions cut costs because

1. They last longer — their two bronze seats are precision ground to a true ball joint.
2. They're easy and fast to install.
3. They *stay* tight — damage no property, spoil no work.
4. They can be used over and over again.

Which is why the answer to "How thrifty, how tight *can you get* is . . . GET DARTS"!

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- Leakproof because precision-machined to a true ball joint and spherically ground
- Shoulders are heavy — can take abuse
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- Bronze alloy seats are extra wide, resist pitting and corrosion
- Practically indestructible nut and body — of air-refined, high-test malleable iron

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DART UNIONS

CALL YOUR LOCAL DISTRIBUTOR FOR PROMPT DELIVERY OF DART UNIONS

## FEED PUMPS

Continued from page 87

cation of the condition of the internal running joints. They give a direct indication of the condition of the balancing device.

If the pump design is such that the pressure drop per inch of wearing-ring and balancing-device length is about the same, the wear rate of the balancing device can be taken as indicative of that of other parts.

For example, if after 50,000 hr operation, balancing-device leakoff doubles, it is likely that wearing-ring clearance has about doubled.

**Spare parts.** To insure restoring a pump to service promptly after an unexpected overhaul, the following spare parts should be kept on hand: one set of casing wearing rings, one set of impeller rings (if used), one set of interstage or diffuser bushings, one spare balancing device made up of rotating and stationary parts (if used), two sets of shaft sleeves, several sets of packing, one set of bearing bushings, and parts for the thrust bearing. A completely assembled spare inner assembly should also be kept on hand.

**Now turn to page 112 for the details of pump overhaul.**

## LEVEL-CONTROLS

Continued from page 107

**Leakage.** If pilot connections leak, check condition of gaskets and replace them where necessary. Don't use threading compounds in control piping. They can work their way into controls, cause sticky operation.

Diaphragm leaks can be tracked down by study of manufacturer's drawings. Simple test—hold bleed nozzle closed. With no air bleeding off, air shouldn't pass through bleed ports. Air through ports, during test, shows up a leaking diaphragm.

Don't forget to check out control-valve operation before putting controls in service. Does the control valve open when air pressure goes up? Or, does it close? In either case, see that pilot setting is consistent with valve setting. If valve is connected to tank inlet, rising liquid level should, naturally, close valve.

---

**Contract to furnish** 8 complete turbines for Barnhart Island hydroelectric plant of N. Y. State Power Authority's St Lawrence Power Project, has been awarded to Baldwin-Lima-Hamilton Corp. Contract calls for fixed-blade, propeller-type units rated 71,000 hp at 94.7 rpm and 81-ft head.

# "Used many makes of turbines... PREFERS COPPUS"

If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
165 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

*This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.*

*This wide bucket "L" type wheel is a new development for use where low water rate is essential*

*This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.*

# COPPUS "BLUE RIBBON" TURBINES

TYPE "RR" MULTISTAGE
BOILER FEED PUMP

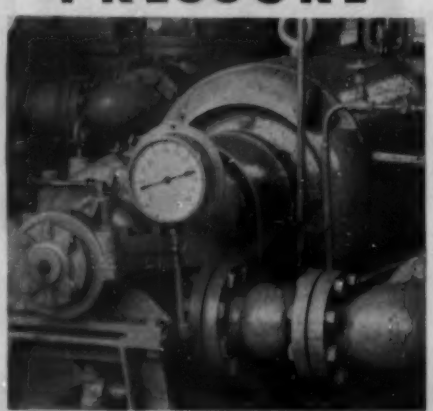
"Buffalo" PUMPS

THE BOILER FEED PUMP
BUILT TO KEEP DELIVERING

Few pump jobs call for the high pressure operation required in boiler feed. Thus, pumps on this important job must have both efficiency and terrific endurance. "Buffalo" offers you both, at moderate price, in the Type "RR" Pump. Delivering at heads as high as 1500' (500 psi), these ruggedly built pumps have been proving themselves dependable and economical in hundreds of boiler rooms for many, many years.

UNDER
PRESSURE

Why not look into the "Buffalo" Q Factor* construction that makes these two and four-stage pumps your best buy? You'll find rugged strength built into every part—oversize ball bearings, shafts and efficient impellers—heavy casings with free-flow water passages—rigid, substantial pump stands. WRITE FOR BULLETIN 980-C TODAY, and check the features that will mean lower cost per gallon for you, year after year!



*The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO PUMPS, Inc.
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"Buffalo" PUMPS

*Subsidiary of Buffalo Forge Company*
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

# APPOINTMENTS

## Corporation executive changes

**Koppers Co, Inc:** W F Munnikhuysen, chairman of the board; Fred C Foy, president and chief executive officer. **The Garlock Packing Co:** J B Sewell, vice-president. **Byron Jackson Co:** Norman D Jesse, Garth F Nicolson, Evan H Sweet and Ross Barrett, vice-presidents. **Rockbestos Products Corp:** Beauford H Reeves, president and general manager. **Irving Subway Grating Co:** James E Irving, president of Western division. **Flexonics Corp:** George G Toepper, vice-president.

## Operations executive changes

**Hagan Corp:** Ralph N Thompson, research manager for Calgon, Inc, and Hall Laboratories, Inc, subsidiaries. **The Babcock & Wilcox Co:** George W Kross Jr, superintendent of tubular products div plant. **The International Nickel Co, Inc:** Kenneth A DeLonge, in charge of iron and non-ferrous castings section of development and research div. **National Gypsum Co:** John Pitts, works manager of Fort Dodge, Iowa plant.

**General Electric Co:** M I Alimansky, general manager of rectifier dept; R E Burris, manager of quality control in gas turbine dept. **Grinnell Co, Inc:** E M Pease, manager of industrial piping div. **National Safety Council:** D L Arm, manager of industrial dept. **National Electric Products Corp:** A N Semmelroth, manager of Torrance, Calif. plant. **Manning, Maxwell & Moore, Inc:** E M Moore, manager of newly created industrial controls div.

**Hartford Electric Light Co:** H T Barrows, superintendent of Middletown, Conn. steam plant, succeeding F L Gibson, retired. **Acme-Hamilton Rubber Mfg Corp:** M M Kahn, director of development for new products. **Consolidated Engineering Corp,** C J Sellner, production manager.

## New sales vice-presidents

**Heyl & Patterson, Inc:** Edward H D Gibbs. **Flexonics Corp:** T K Wells.

**The Swartwout Co:** Ernest H Bellard. **Raybestos-Manhattan, Inc:** H H Burrows, rubber sales. **The Chapman Valve Manufacturing Co:** Frank A Hunter.

## New sales managers

**United States Rubber Co,** mechanical goods div: Edward T Day. **American Chain & Cable Co Inc:** Vincent E Lysaght. **R E Uptegraff Co:** J H Steele.

**H K Porter Co,** Laclede-Christy Co div: Eugene R Hoff, New York district. **John A Roebling's Sons Corp,** electrical wire and cable div. Charles E

# THIS ADVERTISEMENT DOESN'T CARE 2¢ ABOUT SALES

**BUT—**

IF YOU'RE INTERESTED IN LOWEST COST STEAM GENERATION, **MAIL THIS COUPON!**

American Engineering Company
2400 Aramingo Ave., Philadelphia 25, Pa.
Please send me free folder describing the new AE Vibra-Grate—the stoker that's revolutionizing steam generation standards and practice.

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COMPANY_____

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IT DOESN'T MATTER whether you're in the market today. AE's new water-cooled Vibra-Grate Stoker (in sizes from 25,000 to 100,000 lbs. of steam per hour) brings to steam generation a combination of advantages never before approached. The Vibra-Grate is *news*—it's making stoker history and you'll want to know all about it.

Vibra-Grate assures freedom from smoke, even at low ratings. There's no need for dust collectors. It burns low grade coals with top efficiency. It's easily adapted for burning gas or oil in combination with coal or singly. On top of that, Vibra-Grate's overall cost is lower—its water-cooled grate and other features bring minimum maintenance—it is outstandingly efficient at *every* rating. Why go back to poor efficiency to avoid smoke and fly ash when you can have your cake and eat it too with the Vibra-Grate?

But all this merely skims the surface! Mail that coupon and get the whole story about the most important advance in stoker design in decades.

***BY THE MAKERS OF THE INTERNATIONALLY-FAMOUS TAYLOR STOKER***

**AMERICAN ENGINEERING COMPANY**
PHILADELPHIA 25, PENNA.

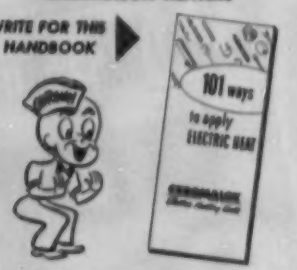
Affiliated Engineering Corporations, Ltd., Montreal 16, P. Q., Bawden Industries Ltd., Toronto 3, Ont.
AE Products are: Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Taylor, Perfect Spread and Vibra-Grate Stokers.

**INCREASE PRODUCTION . . . DECREASE COSTS WITH THESE LOW COST PRODUCTION TOOLS**

Use CHROMALOX Electric Heaters to heat liquids, air and gases. Use them to heat platens, dies, molds and moving metal parts. Use them anywhere you want fast, economical and easy-to-control heat for production line processing. CHROMALOX Heaters are simple to install, efficient, come in types, sizes and ratings for working temperatures up to 1100° F. Most are available from stock.

**FOR IDEAS ON HOW TO USE CHROMALOX HEATERS**

WRITE FOR THIS HANDBOOK

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7731 THOMAS BLVD., PITTSBURGH 8, PA.

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"101 Ways To Apply Electric Heat."

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Company_____
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State_____
I use heat for_____

**CHROMALOX**
*THE BEST IN ELECTRIC HEAT*


# More APPOINTMENTS

Begins on page 210

Meluney Jr, Houston district. **The Trane Co:** Werner G Wassemandorf, reciprocating compressor dept; Lloyd E Eater, fluid cooler dept; Wilfred R Barnard, *UniTrane* dept. **Federal Pacific Electric Co:** C A Schmidt, product sales for *AB* breakers. **Joy Manufacturing Co:** D L Arichibald, New England area.

## New sales engineers

**Enterprise Engine & Machinery Co:** Austin B Crouchley, New York office. **J H France Refractories Co:** Edward C Hirsch, Pittsburgh district. **Sylvania Electric Products Inc:** R M Smart, Midwest region.

## New district managers

**Westinghouse Electric Corp:** Paul B Shiring, electric utility manager, Northeastern region with headquarters in New York, N. Y.; C Spence Purnell, South Pacific district with headquarters in Los Angeles, Calif. **Syntron Cincinnati Sales Co:** Flavel Nelms, Nashville, Tenn.

**Worthington Corp:** R W Bartlett, Detroit. **Diamond Power Specialty Corp:** Herman Krapf, Chicago. **Sterling Electric Motors, Inc:** C E Cotham Jr, Houston. **Tube Turns, Inc:** L O Morris, Mid-Continent territory with headquarters in Tulsa, Okla; D V Pisano, San Francisco; N P Bosemer, Los Angeles; and E R Muir Jr, Northwestern territory with headquarters in Seattle, Wash.

**Rust Engineering Co:** C D McCoy, New York manager and international director. **Graybar Electric Co:** M A Elliston, Abilene. **Minneapolis-Honeywell Regulator Co:** R C Ferguson, Peoria; R R Scott, Davenport. **Allis-Chalmers Manufacturing Co:** J G Winnette, Peoria.

**J F Pritchard & Co:** W W Bodle, Chicago. **Republic Flow Meters Co:** R E Holmes, Philadelphia; S Hammarstrom, Cincinnati. **The Bristol Co:** J M Maitland, Detroit.

## New distributors

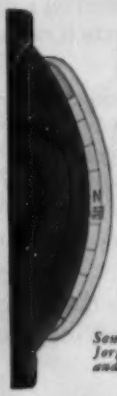
For **Parker Appliance Co:** Louis H Hein Co, 703 Light St, Baltimore 30, Md. For **Automatic Switch Co:** Moorland Co, 120 E 15th St, North Kansas City, Mo. For **General Electric Co,** Carboloy dept: McKee Tool & Supply Co, 925 N Jameson Ave, Lima, Ohio. For **Davis Engineering Co:** Dravo Corp, to handle *Paracoil* heat transfer equipment through its Pittsburgh, Cleveland and Detroit offices.

## New representatives

For **Graver Water Conditioning Co:** Frontier Engineering Services Co, PO Box 1772, Salt Lake City, Utah. For **Chicago Heater Co:** Turbine Equip-

Jersugon Boiler Water Gages give Maximum Visibility, with no blind spots, within the boiler centers available. Special OS&Y valves with horizontal loop keep strain off gage under expansion and contraction conditions; compact design takes less space. Unique gage design with one-piece chamber and staggered glasses and covers eliminates blind spots. You get more gage in the space; more visible glass in the gage.

Gage can be turned at any angle, yet it has no stuffing boxes between gage and valves. Ten standard assemblies, WSP of 650, 900 and 1500 lbs. Visible glass to 18".



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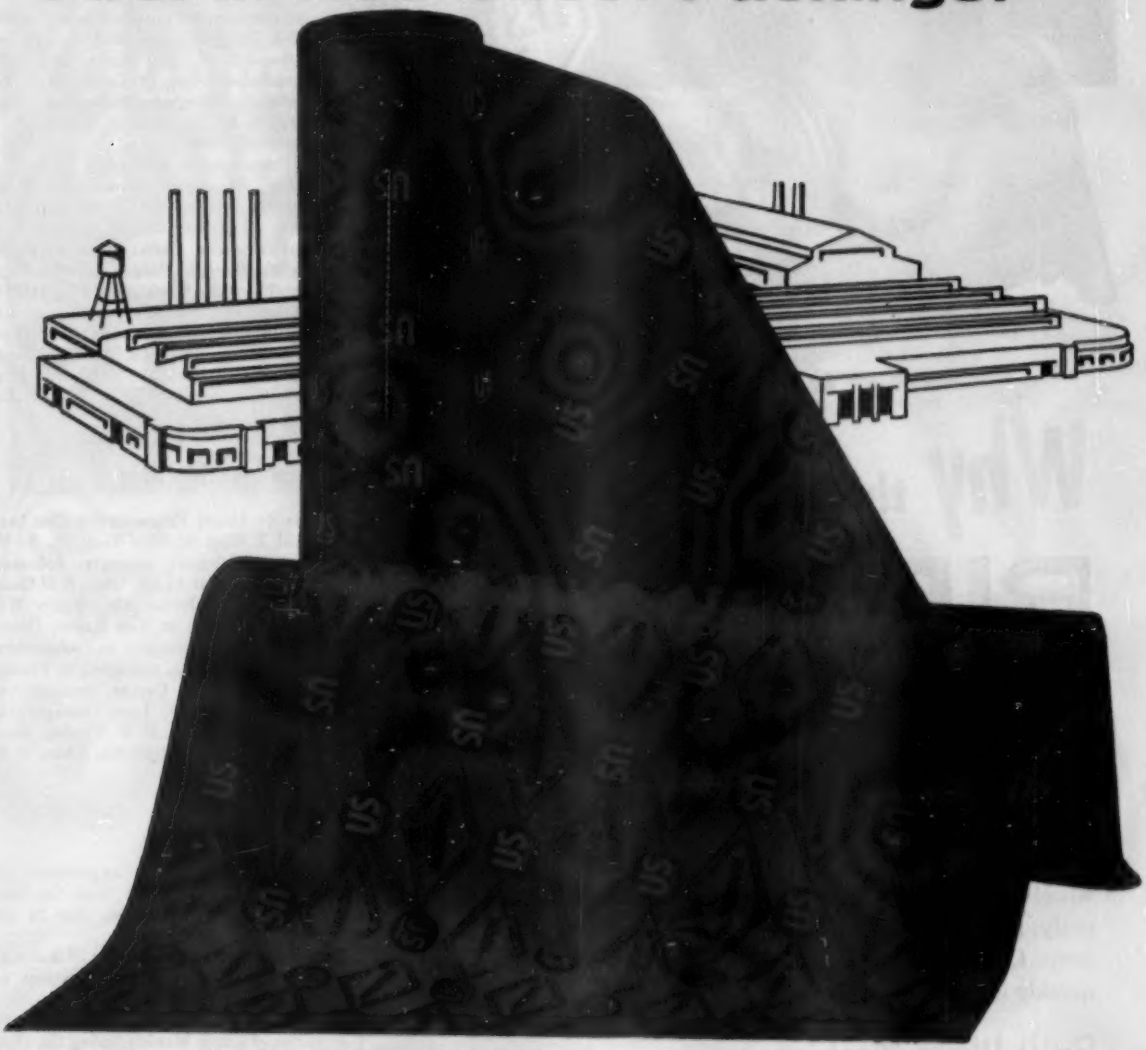

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## More APPOINTMENTS

Begins on page 210

ment Co, 63 Vesey St, New York, N. Y. For **American Flexible Coupling Co:** W J Bernhardt Co, 3041 Bailey Ave, Buffalo, N. Y., and Medor, Inc, 10408 Manchester Ave, St Louis, Mo. For **Bulkley, Dunton Processes, Inc:** Rawson & Co, Houston, Texas; R R Rothrock, New Orleans, La., and Henry P Thompson Co, Cincinnati, Ohio.

For **Hapman-Dutton Co,** Dutton Boilers div: Merrill N Musgrave Co, 2019 Third Ave, Seattle, Wash. For **Roller-Smith Corp:** J G Pettyjohn Co, 234 Daylight Bldg, Knoxville, Tenn. For **The Gas Machinery Co:** Heat & Control, Inc, San Francisco, Calif. For **Equipment Engineering Co:** Hood Engineering Sales Co, 1485 Bayshore Blvd, San Francisco, Calif., and Sierra Industries, Inc, 935 Santa Fe Ave, Los Angeles, Calif.

### New branch offices

**Pacific Coast Engineering Co, Inc:** at 51 E 42nd St, New York 17, N. Y., George J Nicastro, manager. **Johnson Service Co:** at Akron, Ohio, R M Rose, manager; at Mobile, Ala., Walter Williams, manager; at New Haven, Conn., R B Cahoon, manager; at Sacramento, Calif., R C Wang, manager; at Springfield, Mass., J J Curran, manager; at Tampa, Fla., D C Loso, manager; at Wilkes-Barre, Pa., B B Whalen, manager; and at Youngstown, Ohio, R H Anderson, manager.

### Retirements

**Arthur E Mignot,** vice-president of The Wheeler Insulated Wire Co, Inc., div of The Sperry Corp, after 24 yrs service.

**John C Best,** vice-president of National Gypsum Co, and former president of Best Bros. Keene's Cement Co.

**Walter C Hecker,** president and director of Curtis Manufacturing Co, after 50 yrs service.

---

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Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

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These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

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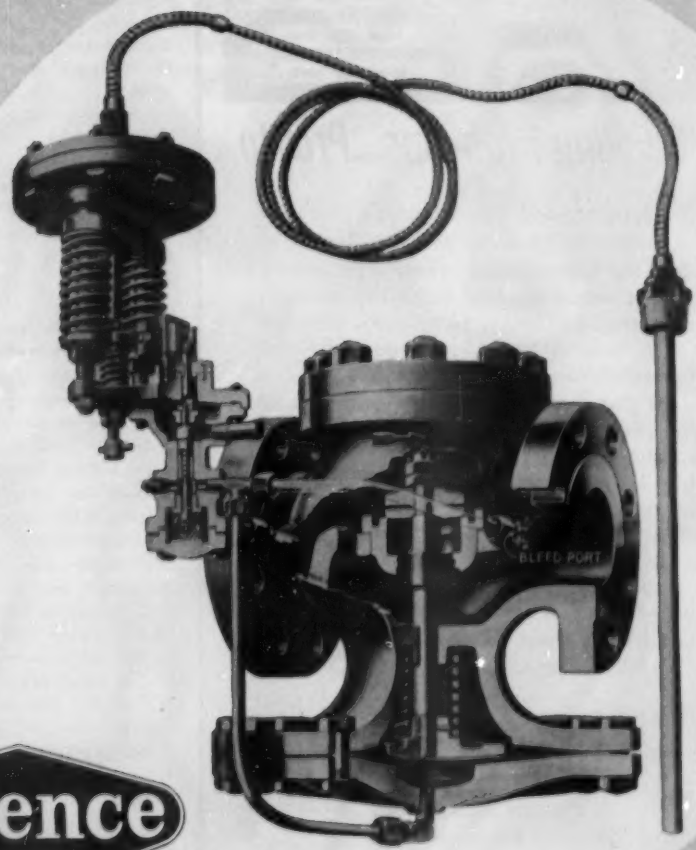


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# More TECHNICAL BRIEFS

Begins on page 154

structure, consisting of the main burner elements, fan, diffuser, throat, etc.

Today we find these and other problems solved for this class of boiler. There has been favorable improvement in a number of design and operating phases, including greater reliability of safety controls, more conservative furnace and heating-surface ratings without a sacrifice in compactness, automatic burners for natural-gas and high-viscosity residual fuels, lower noise levels, improved accessibility and improved manufacturing techniques. *ASME paper no. 54-F-27.*

## Stack design

**The design and comparative costs for high stacks.** *By E J Stankiewicz, Sargent & Lundy.*

Improved dispersion for flue gas by increasing stack heights has introduced new problems and economic considerations for the engineer. This paper reviews these problems in connection with the design of steel, brick and concrete stacks. Relative costs are discussed and charts presented for use in selecting the most economical type.

Factors discussed include vibration of steel stacks, stresses in steel stack design, radial-brick stacks, concrete stack design practice, cost computations, linings, etc. *ASME paper no 54-A-260.*

**Stack heights required to minimize ground concentrations.** *By E W Hewson, University of Michigan.*

The atmosphere is a vast reservoir that may be used for industrial waste disposal. Used wisely, it permits disposal without damage or nuisance; used without due consideration of its widely varying diffusing capacity, wastes may at times remain at sufficiently high concentrations near the ground to cause annoyance, and even illness and death.

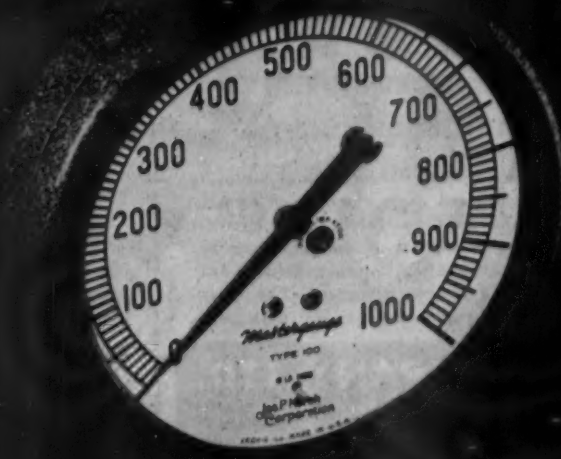
A primary factor in determining whether or not industrial wastes emitted to the atmosphere will be a nuisance is the stack design. Generally speaking, higher the stack and greater the exit velocity, the better is the design.

But improvement at the ground does not vary proportionally with increasing values of height and velocity. Also, economic and other factors limit height and exit velocity.

There are thus optimum design values which vary with climatic conditions, topography, plant configuration, composition, temperature, and exit velocity of effluents, etc. The purpose of this

Directions for ordering papers on p 224

# MARSH

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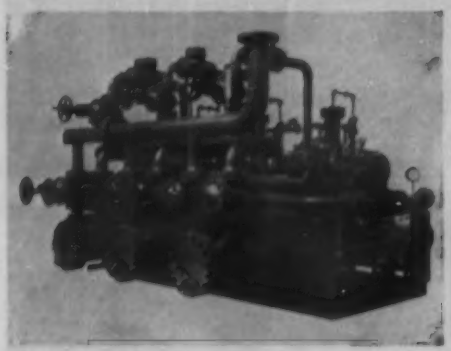

The compact, high-pressure Unit shown consists of one Turbine-driven and two Motor-driven Pumps, and three Shell-and-tube-type Oil Heaters mounted on a single frame. Capacity 50,000 pounds per hour of bunker C fuel oil against 400 P.S.I. One pump and heater are spares.

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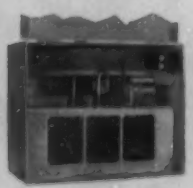
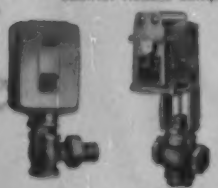


Dual Bulb Controls



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# More TECHNICAL BRIEFS

*Begins on page 154*

paper is to suggest to the stack designer a method of approach that will permit computation of the concentrations to be expected with various stack characteristics over level terrain. In rough country and near shorelines, modifications of the method are required. *ASME paper no. 54-A-211.*

## Air pollution

**A technique for the rapid solution of an air-pollution equation.** *By F T Bodurtha, Jr, E I du Pont de Nemours & Co, Inc.*

A technique for rapid solution of the Bosanquet and Pearson formula for atmospheric gas concentrations is developed in this paper. Equations and graphs presented refer to stack gases at or near atmospheric density.

General consideration is given to stack gases whose density differs from atmospheric. It is indicated that the total plume rise may decrease with increasing stack-gas velocity when the effluent density is less than atmospheric. *ASME paper no. 54-A-187.*

**Cleveland co-operative meterological and air-pollution program.** *By H J Scott, commissioner of air pollution control, Cleveland, Ohio.*

Through the united efforts of 14 major industries, the U.S. Weather Bureau and the Division of Air Pollution Control of the City of Cleveland, relationships between air pollution and meterological factors over a large industrial area have been and still are being studied.

This program was conceived, organized and placed in operation to determine, if possible, the effect of meteorological data on the concentration of air pollution. Sampling stations have been set up in an industrial area and simultaneously operated for extended durations over a 3-yr period. A tremendous amount of data have been accumulated to substantiate conclusions discussed in this paper.

This group adopted standard equipment and sampling methods, recorded pollution and meteorological factors, and then statistically analyzed these data. A method of forecasting the amount of air pollution to be expected is presented. *ASME paper no. 54-A-166.*

**The removal of sulphur-dioxide from power-plant stack gases.** *By R L Rees. British Electricity Authority.*

So far as is known, the only power stations in the world in which flue gas

*Directions for ordering papers on p 224*

# NEW STANODIESEL OIL M

A new stationary industrial engine lubricant developed specifically to meet problems posed by new engine designs, higher loads, economy fuels

New STANODIESEL Oil M meets—and with plenty to spare—the performance requirements imposed on diesel lubricants by new engine designs, higher loads and the use of economy fuels. It meets these requirements because, first of all, it is an oil refined from the finest quality base stocks. It thus has superior stability. Then additives exclusive with STANODIESEL Oil M have been blended with these base stocks. The additives do these things:

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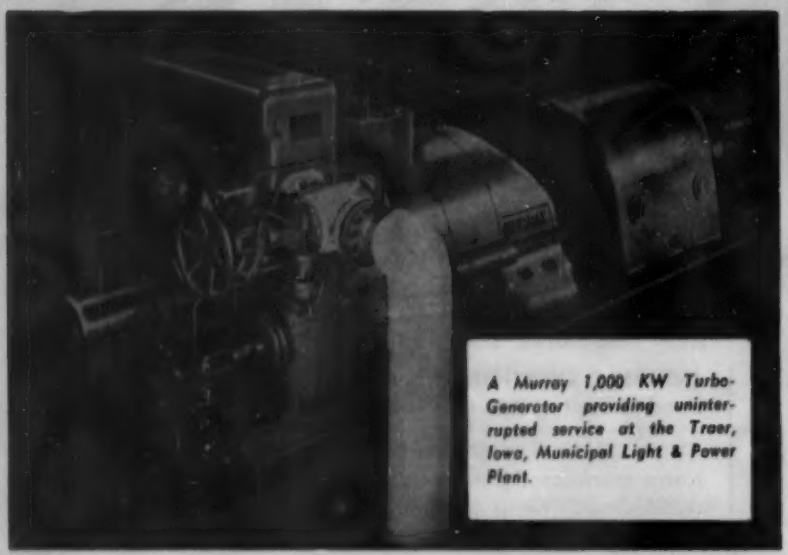
# Murray Turbines



*A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.*

● A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a *must*.

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## More TECHNICAL BRIEFS

*Begins on page 154*

is washed are in Great Britain, where the Battersea process is in use at the Battersea and Bankside Power Stations in London.

Although power plants burn only about 20% of the total amount of coal consumed in the country, and mostly discharge stack gases into the atmosphere at a much higher level than other consumers, there has been continued interest for many years in the possibility of lowering the concentration of sulphur dioxide in stack gases.

Interest has been intensified by the rate of growth of electric generation, by the trend towards concentrations of more than 1.5% of sulphur in the fuel, and by the effects of the London fog of December, 1952.

The paper discusses the problem of sulphur-dioxide removal, reviews the adequacy and cost of available processes, mentions research in progress, and briefly considers the effect of flue-gas washing on air pollution. *ASME paper no. 55-APC-2.*

### Controls

**Installation and maintenance of flow meters.** *By Martin J Ladden and Richard P Connors, Minneapolis-Honeywell Regulator Co.*

This paper gives general and basic information on installation and maintenance of flowmetering equipment. It is agreed that flowmeters, because of the nature of their work, require maintenance and care. But much of the difficulty met with such equipment is due to neglect of these basic rules.

Much background and experience is needed in flowmeter design and application to properly protect the units they serve. To be certain of continuing good operation, it requires both the ability to repair under possible breakdown conditions and, just as important, the ability to sustain a preventative maintenance program that is realistic and can be carried out.

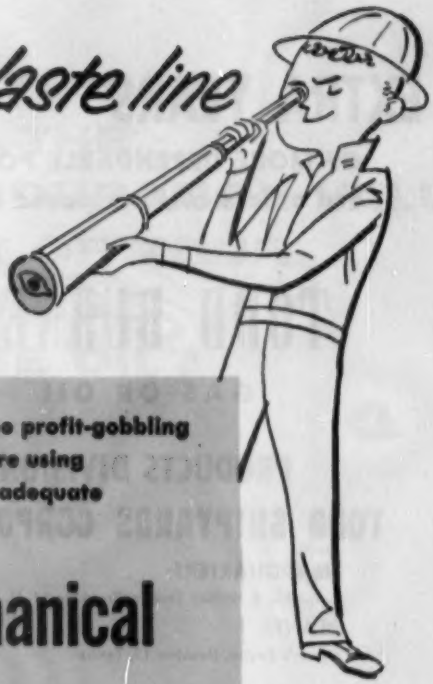
Both these phases require an organized program with standardized procedures for proper integration of work performed by different individuals. Practical records of each installation should be kept and made available to the men charged with keeping the equipment in good operating condition. *ISA paper no. 54-21-4.*

**Industrial applications of electromagnetic flowmeters.** *By Gerard H Giczewski, Bowser, Inc.*

The electromagnetic flowmeter is cap-

*Directions for ordering papers on p 224*

# Watch your pump's Waste line



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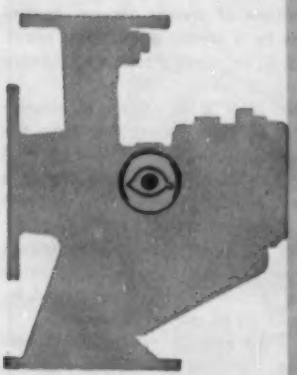

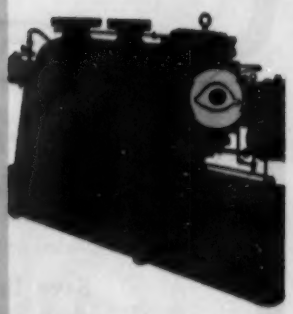

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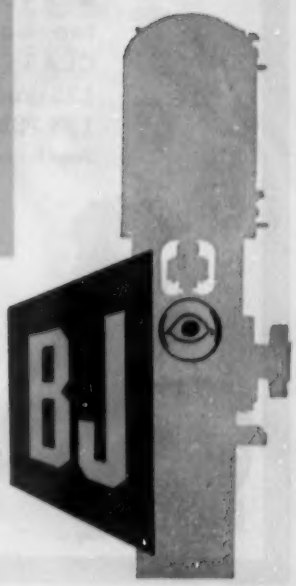

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## More TECHNICAL BRIEFS

*Begins on page 154*

able of handling a wide variety of liquids safely, economically, and with considerable accuracy. The one limiting factor in its use is the requirement that the liquid be conductive.

Liquids that can be handled include most inorganic acids, many inorganic soluble salts and inorganic basic compounds. Organic compounds may or may not be conductors, depending upon the amount of mxed or dissolved water in the compound.

The electromagnetic flowmeter opens many new fields to liquid metering. They are discussed in some detail in this paper. *ISA paper no. 54-45-1.*

**Applications of newer process control concepts to a steam generating plant.** *By R S King, Corn Products Refining Company.*

In the early days of steam generation, the control device requiring the operator's closest attention was his coal shovel. The boiler had a pressure gage to show him how he was doing with the shovel. There was also a sight glass for drum level. Probably a superintendent would attract the operator's attention concerning the air-fuel ratio, gaged by the blackness of the stack smoke.

Today the average conventional control panel contains a number of instruments for safe and efficient operation. Most operators must go through a long training period to learn the use of these instruments. Though he may never understand the control system, he will eventually control the boiler—through ritual.

High labor turnover in a new boiler plant fitted with conventional panels led to studies to improve this condition. Solution called for abandonment of the present boards, building a central control room and designing new boards for all boilers. This solution was based on economic justification.

The panels developed for vital and non-vital instruments are excellent examples of good judgment applied to the solution of this important problem. Drawings and photographs show various aspects of the panels and their design. *ISA paper no. 54-31-1.*

## Hydro development

**An automatic hydroelectric development.** *By J L Harvey, Niagara Mohawk Power Corp.*

Stewart Bridge is the most recently built hydro station on this system. It has many predecessors—83 to be exact. The first, built in 1895, and the second,

*Directions for ordering papers on p 224*

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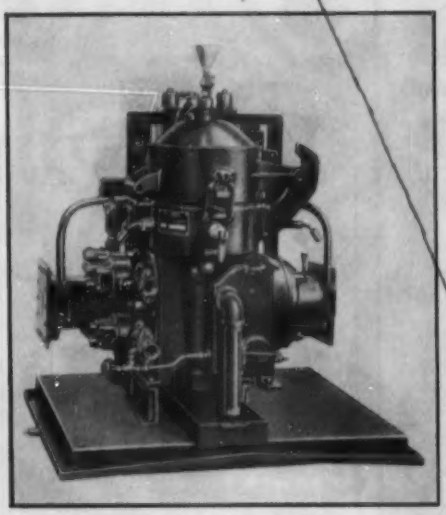

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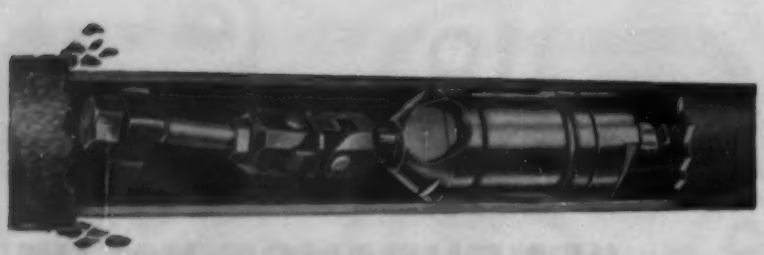

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You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

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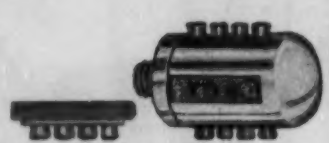
### Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.

Model SS2S ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model SS0S ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.


## More TECHNICAL BRIEFS

Begins on page 154

built in 1897, are still operating today.

Rated output of the single generating unit is 30,000 kw. Speed of this vertical-shaft machine is 106 rpm, head 97 ft, discharge at full gate 5500 cfs.

There are no regular attendants at Stewart Bridge, the station being remotely controlled by carrier current from Spier Falls. Control is unique in that signals are not sent and received in form of time division codes and sequences of one frequency. Rather they are sent and received over separate frequency channels.

Quartz-crystal tuning at both receiving and sending ends gives reliable discrimination for frequencies differing by less than one tenth of one per cent. Many other details of the control system are covered in this interesting paper. *AIEE paper; no number.*

### TO OBTAIN COMPLETE TEXT

*Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not* POWER.

*American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39 St, New York 18, New York.*

*Paper identified as MVEA, no number, is obtainable on request from The Permutit Co, 330 W 42nd St, New York 36, New York.*

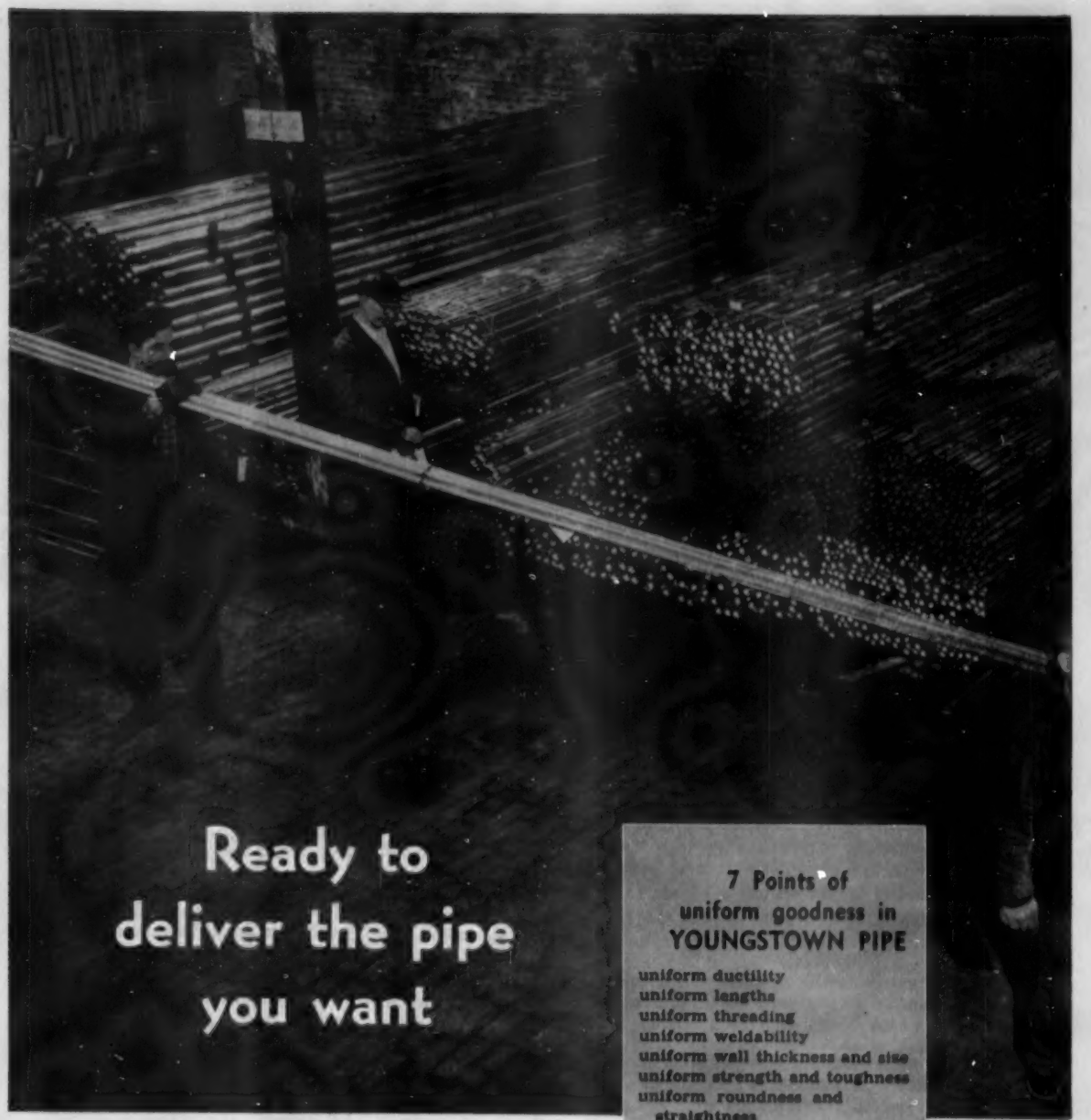
*Papers T-128 and T-129 are available on request to Graver Water Condtioning Co, 216 W 14th St, New York 11, New York.*

*Instrument Society of America. Identified by initials ISA and obtainable through ISA, 1319 Allegheny Ave, Pittsburgh 33, Pa.*

*American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39 St, New York 18, New York.*

**Three members of** Sigma Tau, honorary college engineering society, have been presented "Merit Awards" for outstanding services to that organization. Honored were Dr Walter Wohlenburg, dean of engineering, Yale University; Albert N Gonsior, director of engineering, P Ballantine & Sons; and Stanley Bracken, chairman of the board of Western Electric Company.

**Industrial motion pictures** available on a free loan basis from U.S. Steel Corp are described in a new catalog, obtainable from the company at 525 William Penn Place, Pittsburgh 30, Pennsylvania.



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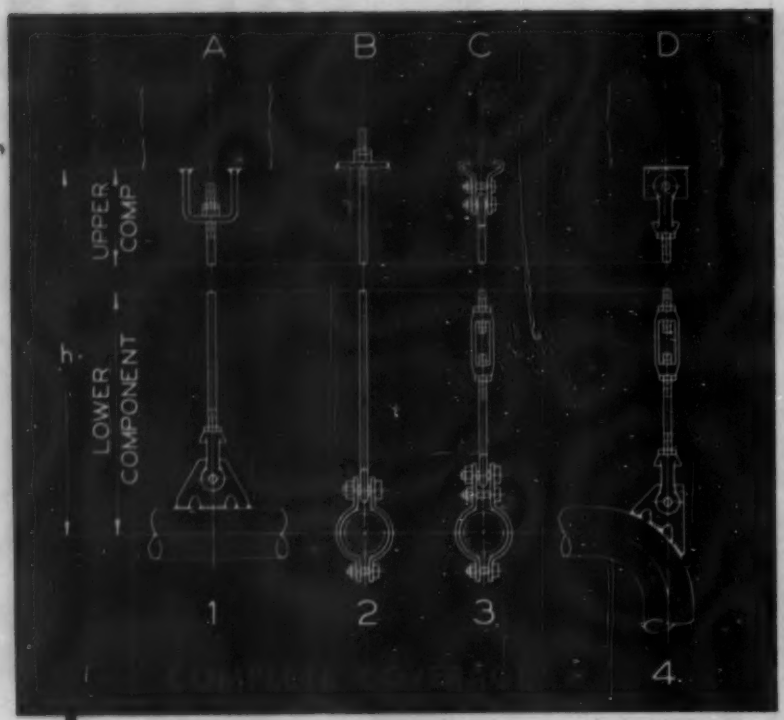


*This is article number 6 in a series dealing with the subject of pipe supports in modern power and industrial plants.*

Every engineer who has ever been responsible for the design of a pipe supporting system recognizes the tremendous amount of time which must be devoted to the detailing of necessary supports. Several years ago, Bergen began to develop a group of standards covering a wide range of beam and pipe connections designed for an equally wide range of loads. The purpose of such standards being to eliminate, or at least minimize, the need of detailed drawings.

To demonstrate the simplicity of these standards, let us consider an example of standard assemblies taken from one page of the Bergen catalog and reprinted above.

Assume: the hanger identification mark to be "CH3"; a load of 1,000 lbs.: A preference for upper component "D" and lower component "2": A pipe size of 8": And a distance from steel to pipe center of 3'-6". A simple schedule in the following form is all that is required.

CH3—Bergen 5-D 2-8"
h = 3'-6"

(The load prefix of 5 corresponds to a 1,000# load and is taken from a table in the catalog, too bulky to be reproduced here.)

This is a hanger complete in all respects, designed and fabricated with a minimum factor of safety of five. It is shop fabricated and assembled and is shipped to the job bearing the identifying mark of CH3 as illustrated.

BERGEN PIPE SUPPORT CORP.
[illegible] Church Street, New York 7, N. Y.

# BOOKSHELF

**Diesel Engine Operation and Maintenance.** *By Vladimir L Maleev, thermodynamics engr, North American Aviation Corp. 504 pp, 6x9, illus. tables, $6.50. McGraw-Hill Book Co, 330 W 42nd Street, New York 36, N. Y.*

Divided into five parts, this text covers basic principles and construction, engine components, fundamentals of diesel installation, engine installation and operation, and maintenance and repairs. A glossary of terms used in diesel engineering and a list of visual aids are included.

One outstanding merit of this book is its concise yet comprehensive coverage of principles and construction. The large number of illustrations should make it of real value to any engineer—newcomer or oldtimer—interested in latest details of all types and a large number of makes of diesels.

The 148 pages devoted to engine installation, operation and maintenance are valuable aids to every engineer concerned with any phase of keeping engines on the line. These pages cover items like installation, engine selection, rating-testing, maintenance records and data, repairs, overhauling, salvaging and preventive maintenance methods.

**Water Hammer—Its Cause, Magnitude, Prevention.** *By Oscar C Goldman, supt, city distribution div, San Francisco Water Dept. 116 pp, 6x9, illus, cloth, $5.00. Columbia Graphs, Columbia, Conn.*

This book presents a complete solution to the problem of water hammer. Stated in general terms, solution may be applied to all cases of water hammer in piping systems.

By using methods given it is possible to analyze and calculate intensity of any water-hammer surge that might be developed, as well as to design against it by eliminating its destructive effect. Solution is easy, simple and direct. No complex diagrams or equations are required.

**Hydraulic Handbook.** *Compiled by Fairbanks, Morse & Co, 6x9, 256 pp, illus, tables, cloth, $3.50. Available from Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill., and branch offices of the Company.*

Compiled as an aid to engineers who plan installation of pumping machinery, and to plant managers and operators responsible for efficient functioning of machinery, this book is a worthwhile contribution to its field.

It includes enough fundamental principles of pumping to serve as a refresher for those who work with pumping application problems at infrequent intervals. Also included are tables and data of value to everyone who plans pumping equipment for public works, industry or agriculture.

Sections in the book cover hydraulic fundamentals, pipe friction, conversion factors, water data, viscous liquids, volatile liquids, solids in suspension, chemical liquids, mechanical and electrical data and pump testing.

(*More Bookshelf on p 228*)

KIRK AND BLUM

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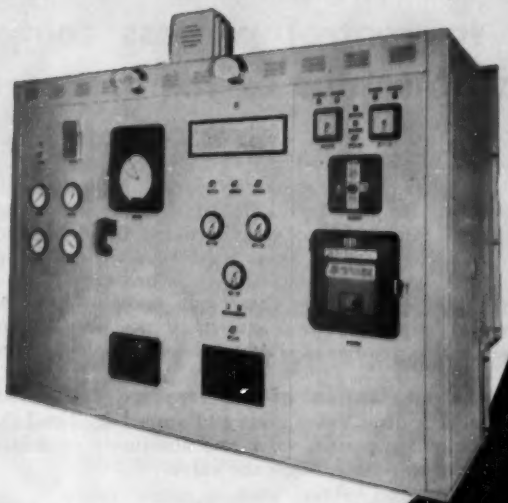

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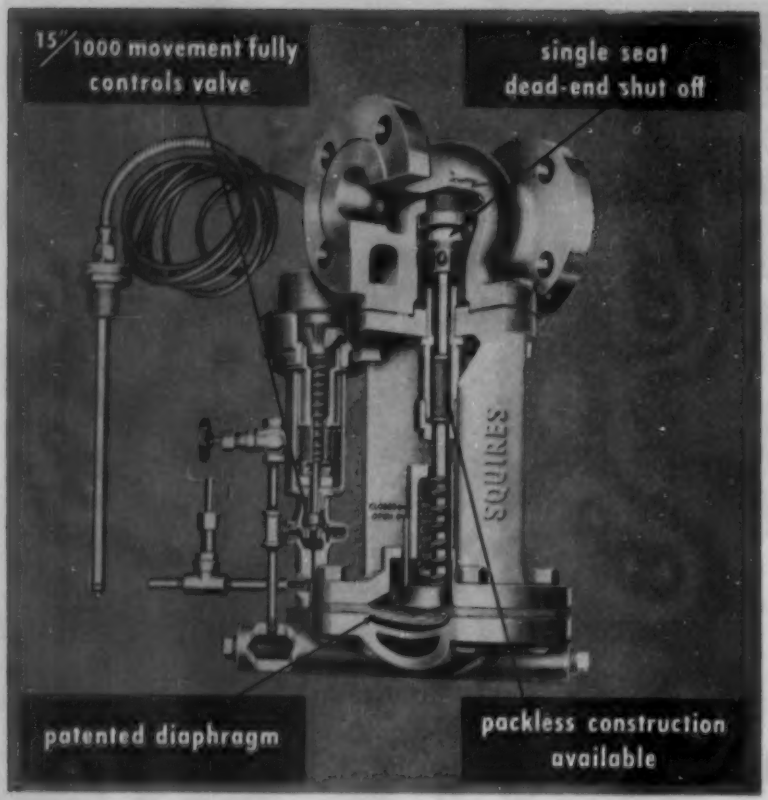
Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog. The Kirk & Blum Mfg. Co., 3233 Forrer St., Cincinnati 9, Ohio.

KIRK AND BLUM

SHEET METAL FABRICATION




## How to control process temperatures to within plus or minus one degree

When you use steam or water as a heat source, close control of process temperatures is simply a matter of using a temperature regulating valve that has precise accuracy. A Squires Pilot Operated Temperature Regulator provides plus or minus one degree control because the pilot valve only has to move .015 inches to fully open or close the main valve. *In actual operation, the pilot valve only moves .004 inches (the thickness of an ordinary piece of paper) to modulate the main valve. Thus, movement of pilot bellows is so slight that long pilot life is assured . . . maintenance is practically non-existent . . . long range cost is lowest in the industry.*

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For additional information on how to get better control of steam, water, air or gas, write for Squires Valve Booklet No. 5417. The C. E. Squires Co., 18502 Syracuse Ave., Cleveland 10, Ohio.

5-103

SQUIRES

# More BOOKSHELF

Begins on page 226

**The Vertical Pump by Johnston.** *Compiled and edited by A W Moore and Howard Sens, Dozier-Eastman and Co. 7x10, 392 pp, illus, tables, cloth, $10.00. Johnston Pump Co, 3272 E Foothill Blvd, Pasadena, California.*

Devoted exclusively to vertical pumps, this book should be of much help to engineers who must solve industrial pumping problems. First designed for deepwell service, vertical pumps today have a large number of industrial uses. Leading authorities and publications in the field have contributed much of the material for this book.

Sections cover development of groundwater resources, pump construction, design and performance, pump selection for hot, volatile, viscous and corrosive fluids, practical pump application, engineering formulas and data.

A large number of illustrations of vertical pumps and their typical applications make the volume a useful tool to every engineer using, specifying or purchasing vertical pumps. A few typical applications discussed are primary water supply, hydropneumatic-tank operation, irrigation, flood control and drainage, sewage collection and treatment, cooling-water services, mine dewatering, pipeline pumping and boosters, oil pipelines and secondary oil recovery.

**Conversion Factors and Tables.** *(Second edition, 1955.) By O T Zimmerman and Irvin Lavine, professors of chemical engineering, University of New Hampshire. 4½x6, 525 pages, $5 in U. S. Published by Industrial Research Service, Inc, Masonic Bldg, Dover, N. H.*

Like the first edition in 1944, second edition of this book is designed to save time for engineers, scientific and technical workers. Present edition incorporates invaluable features of the original work, and is expanded and recalculated, based on latest accepted fundamental values.

Book provides a convenient source of fundamental physical relationships, as well as several thousand constants for conversion of units.

Contents include definitions and fundamental values; physical constants; a large section (249 pages) on conversion factors in U. S., British and Metric units, including factors on weights, measures, velocities, mechanical, electrical, thermal, refrigeration, hydraulic, surveyors and other units; foreign conversion factors; foreign monetary equivalents; conversion tables for temperatures, thermocouples, pressures, viscosity, hardness, etc.

**Radiant Heating.** *(Second Edition). By Richard W Shoemaker, professional engineer. 6x9, 346 pp, $7. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

Contains practical planning and construction help on how to design and install radiant heating systems. Step-by-step design methods are given for all types of structures—industrial, commercial, private.

Subjects covered include general considerations, structural and other advantages, examples of typical applications, the radiant-heating plant, controls, design pro-

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Anchor Vy/Flex packing is furnished in pre-formed ring sets only and should be used preferably in the Ankor-Nest construction. However, it is available in rings of square cross section—endless or split, as ordered.

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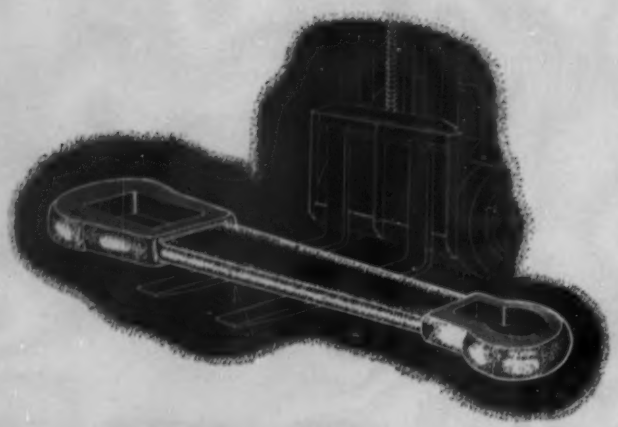

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**VANDERLOY*** **an electrolytic iron that bonds atomically with most ferrous metals, aluminum, copper, nickel and their alloys.**

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*Patents applied for

**SpurTan Engineering West Coast Licensee


## More BOOKSHELF

Begins on page 226

cedures, installation, radiant cooling including heat-pump applications, electrical applications, miscellaneous applications and a precise method for designing radiant-heating systems.

**Water Conditioning for Industry.** *By Sheppard T Powell, consulting engineer. 6x9, 548 pp, $9. McGraw-Hill Book Co, 330 W 42nd St, New York 36, New York.*

This book gives a thorough, modern presentation of all effective water conditioning methods, from simple to complex. Specific methods and types of apparatus are described in detail. Included is information on design features, control required for effective performance, installation and operation costs, and other facts to aid in selection and operation for industrial water uses.

The book shows how to obtain good water quality to solve problems of corrosion control, embrittlement of boiler steel, and steam quality. Also, emphasized is the treatment of water for high-pressure boilers.

Presentation includes review of latest types of evaporation and deaeration equipment, treatment of water in recirculating systems, silica removal, and acid cleaning. Testing methods, calculations, and interpretation are also covered.

**Industrial Utility of Public Water Supplies in the United States, 1952.** *Part I, Water Supply Paper 1299 $2.25; Part II, Water Supply Paper 1300, $1.75. Prepared by E W Lohr and S K Love of the Geological Survey. Government Printing Office, Washington 25, D. C.*

These two companion reports give data on public water supplies of larger U.S. cities. Part I covers 819 cities east of the Mississippi River; Part II gives data for 496 cities west of the Mississippi. The reports give up-to-date information on chemical quality of public waters of these cities, superseding Water Supply Paper 658 dated 1932.

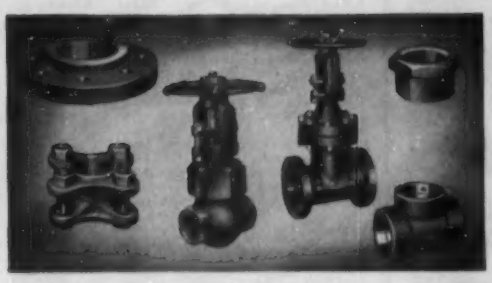
Data includes population supplied for each city, ownership, sources and treatment of supply, storage facilities for both raw and finished water, and chemical analysis of supplies. Each report carries brief discussions on treatment of public, industrial and domestic supplies. Emphasis is on hardness, iron and manganese, and corrosion.

---

**A one-week course** in "Gas turbines and free piston engines" will be given at the University of Michigan, June 13-17. The course will cover centrifugal and axial compressors, radial inflow and axial turbines, high temperature metals, combustion, fuels, performance, stress analysis, thermodynamics and design problems of free piston engines. Full details from Prof F L Schwartz, dept of mechanical and industrial engineering, U of Michigan, Ann Arbor, Michigan.

**Board of directors** of American Institute of Electrical Engineers has authorized formation of the Baton Rouge, La. section, bringing total number of sections to 107.

# Designed for today's *Tough* service demands



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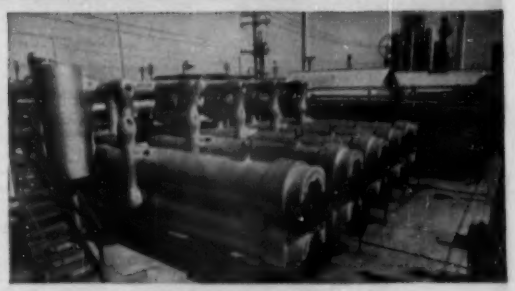
Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

**PROCESS EQUIPMENT FOR EVERY SERVICE**

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



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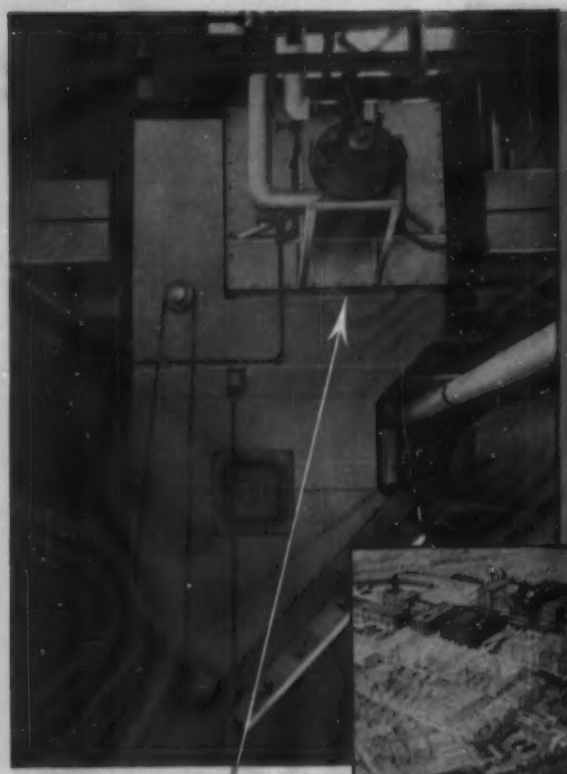
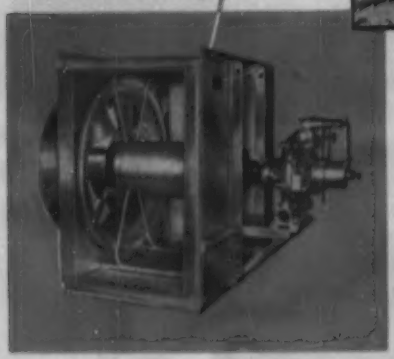


Showing Wing Draft Inducer installed as elbow in breeching.

SPACE PROBLEM SOLVED BY WING PACKAGED POWER PLANT DRAFT INDUCER



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May be Turbine or Motor-Driven. Fan and bearing assembly may be withdrawn from housing for inspection and servicing.

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At P. Ballantine & Sons, Newark, N.J., a 70,000 lb./hr. boiler was installed with forced draft supplied by a Wing Turbine Blower. A 200-foot stack served this and one other boiler. Lightning removed 30 feet of the stack making the chimney draft inadequate. Conventional fans, because of large space requirements, would not do. A Wing Packaged Draft Inducer was installed in the existing breeching with no major changes and within the available space. *More facts about Wing Draft Inducers in Bulletin 1-55. Use the coupon.*

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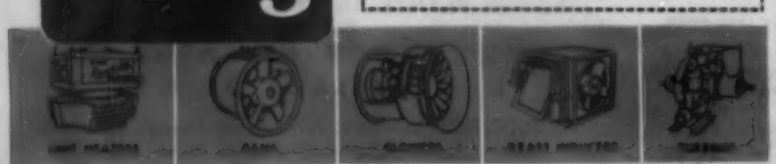



## More FREE BULLETINS

Begins on page 167

**16** **Control systems** for nuclear reactors. 8-page folder ND46-70-700(1) contains photos, diagrams, specs of complete "package" control systems for any type of research or power reactor. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pennsylvania.

**17** **Liquid level control,** measurement and transmission, is subject of illustrated 22-page bulletin 1161. Various systems are described along with applications, principles of operation, limitations and advantages. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pa.

**18** **Metal-clad switchgear** rated 2.4 to 13.8 kv and 50 to 500 mva is described in 52-page bulletin GEA-5664C. Includes applications, installation, maintenance, design features, tables of dimensions and weights, full specs. General Electric Co, Schenectady 5, New York.

**19** **Eddy-current brakes.** Air and liquid cooled types described in 12-page bulletin BR-1. Includes construction details, capacities, characteristic curves, dimensions and advantages. Dynamatic div, Eaton Manufacturing Co, Kenosha, Wis.

**20** **Air circuit breakers.** Selection and application discussed in illustrated 16-page booklet. Federal Pacific Electric Co, 50 Paris St, Newark 1, New Jersey.

### ELECTRICAL EQUIPMENT

**21** **Distribution transformers,** *Type UD,* ranging from 3 to 100 kva are detailed in 8-page bulletin 135. Photos, characteristics, dimension drawings of overhead, oil-immersed units. R E Uptegraff Manufacturing Co, Scottdale, Pa.

★ **Electrical products** for industry and home are listed in 48-page catalog. Includes more than 600 items. ★Request direct, using company letterhead, from Advertising dept, Rodale Manufacturing Co, Inc, Emmaus, Pa.

### SAFETY AND MAINTENANCE

**22** **Accident prevention signs** in 3 standard sizes—5x14-in., 3½x10-in., and 2¼x9-in.—are described in 16-page bulletin 145-C. Self-sticking signs are shown in full color. W H Brady Co, 727 W Glendale Ave, Milwaukee 12, Wisconsin.

**23** **Repairing floors.** Single sheet bulletin E-37 gives 7 steps for repairing mortar joints of brick or tile floors. The Master Builders Co, 7016 Euclid Ave, Cleveland 3, Ohio.

**24** **Machinery mounts.** Construction data, photos, diagrams, selection charts in 8-page bulletin 546. Barry Controls Inc, 1000 Pleasant St, Watertown, Mass.

**25** **Packings** for general and special services. Illustrated 50-page bulletin contains photos, engr data, recommendations, full specs. The Allpax Co, Inc, Mamaroneck, New York.

### MATERIALS HANDLING

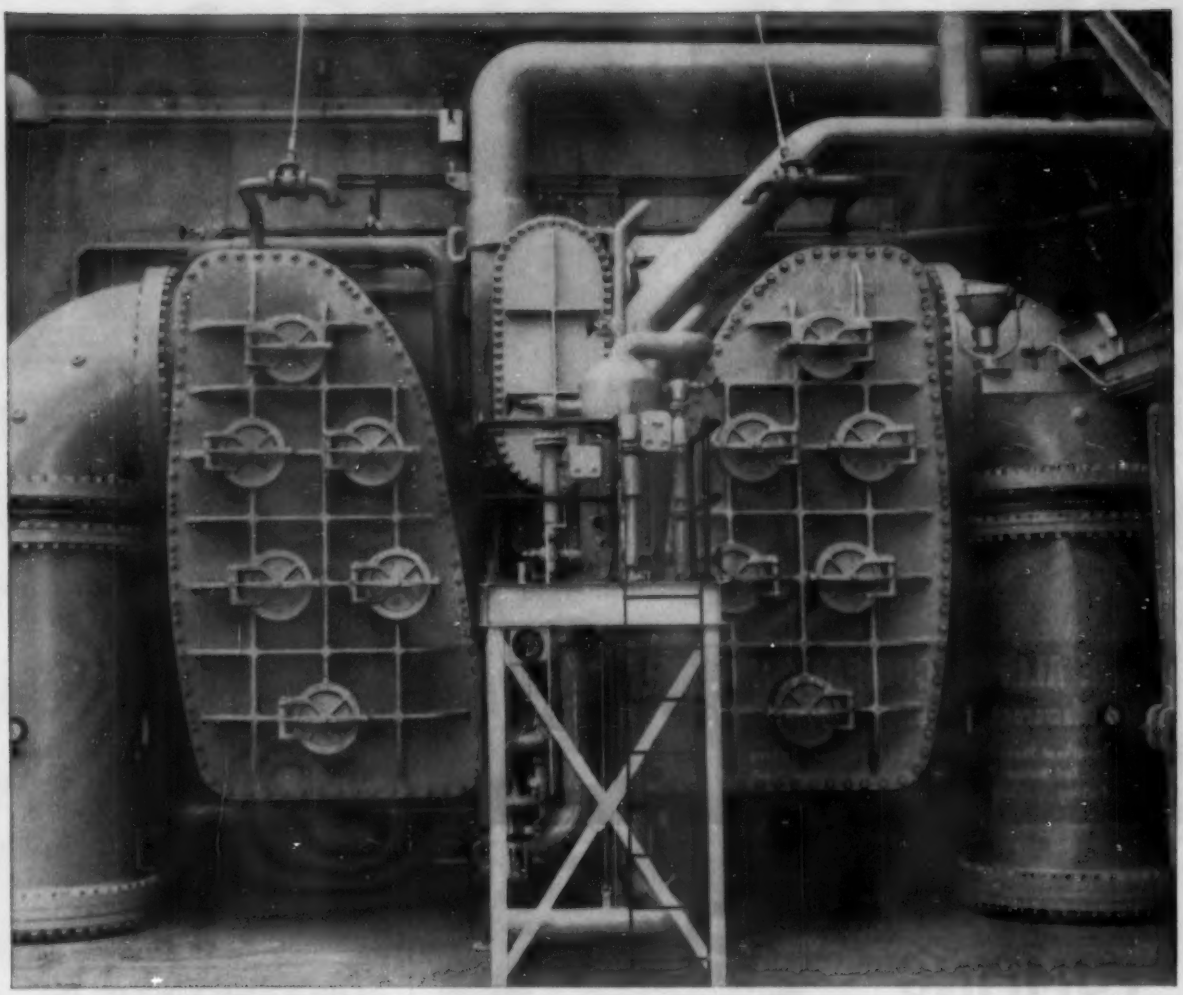
**27** **Variable speed pulleys.** 8-page bulletin lists advantages of units and is documented with graphs, diagrams, cutaway views and photos. Dept KP, Equipment Engineering Co, 2853 Columbus Ave, Minneapolis 7, Minn.

**28** **Pneumatic conveying systems.** Schematic drawings, applications in 12-page bulletin 105. Convair, Inc, 712 Brookline Blvd, Pittsburgh, Pa.

### METERS AND INSTRUMENTS

**29** **Industrial instruments** and equipment described in 26-page bulletin 5003. Includes photos and descriptions on pyrometers, potentiometers, temperature detectors, thermometers, pressure gages, flow and liquid level meters, etc. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pa.

(*Continued on page 234*)



*four FW condensers serve*

# PG & E's NEW PITTSBURG PLANT

COMPLETELY modern in every detail of design and equipment, the Pacific Gas and Electric Company's new 660,000 kw plant at Pittsburg, California, is the largest steam power plant west of the Mississippi.

Each of the 165,000 kw turbines is served by a Foster Wheeler Cross Flow type, single-pass condenser as shown above. With 65,000 sq. ft. of condensing surface, each of these four FW units has a rated condensing capacity of 726,000 lb of steam per hour, with a turbine exhaust pressure of 1.3" hg absolute and 98,600 gpm of circulating water at 60 F.

A space-saving feature of this condenser design is the location of the FW low-pressure heaters in the intake passage between the cross-flow tube banks. This heater arrangement can be seen in the center of the photograph above.

With this latest installation, PG&E has purchased a total of 14 large condensers from Foster Wheeler in the last 10 years. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

**FOSTER WHEELER**

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Contact your nearest distributor.

Now is the time to get the facts about ALLPAX Packing just in case you haven't already used it and are unfamiliar with its superiority and economy. For example, ALLPAX can be depended on to maintain a leakproof film between packing and shaft even under excessive pressures, yet without undue pressure exerted in the stuffing box. It is specially lubricated and is available for stuffing boxes of any size and shape.

Style 1 ALLPAX is for general service and is available in coil and in loose form. Style 2 is also a general utility packing but is designed for high temperatures (over 600°). Investigate today.

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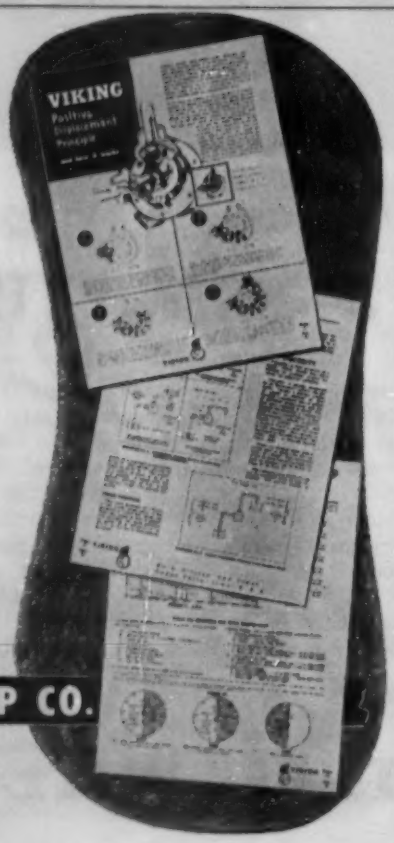


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Cedar Falls, Iowa

*See our catalog in SWEETS*


## More FREE BULLETINS

Begins on page 167

**30** **Recording thermometers** and gauges, dial indicating thermometers described in 8-page bulletin G-158-A. Specs, diagrams, photos. The Electric Auto-Lite Co. Instrument and gauge div, Toledo 1, Ohio.

**31** **Digital converters,** electro-mechanical shaft position and voltage, types. Operation, characteristics, specs, photos and drawings in 12-page catalog 58-10. Fischer & Porter Co, 302 Jacksonville Rd, Hatboro, Pa.

**32** **Full view rotameters** for flow measurement and control. Construction and safety features, capacity charts, dimension drawings, photos in 20-page bulletin 115. Brooks Rotameter Co, Lansdale, Pennsylvania.

**33** **Liquid-filled thermostat** is designed to provide accurate control of process and oven temperatures at electrical loads to 15 amps. Photos, specs in 2-page bulletin MC-122. Fenwal Inc, Ashland, Massachusetts.

**34** **Sight flow indicators** for use on any pipe line ½ to 2 in. Photos and specs in 2-page data sheet 253. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Massachusetts.

### PIPING, VALVES, FITTINGS AND SPECIALTIES

**35** **Conduit** for underground piping. Cutaways, diagrams, specs in 8-page bulletin 10154. Porter-Hayden Companies, 825 Freilinghuysen Ave, Newark 5, N. J.

**36** **Air control valves** for high- or low-pressure installations. Illustrated 66-page catalog includes data on cam, flow control, foot, hand, interlocking, pilot, pressure regulator, quick exhaust, sequence, solenoid and time delay units. Airmatic Valve, Inc, 7317 Associate Ave, Cleveland 9, Ohio

**37** **"Super-Seal** explains the *Shear Seal* principle" is topic of comic-book bulletin describing technical development of new valving principle. Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, California.

**38** **Multiport relief valves** for steam, air or gas service. Photos, diagrams, construction charts, specs, sizing data in 20-page bulletin 5200. Cochrane Corp, 17th St, Philadelphia 32, Pa.

**39** **Steam traps** for low, medium and high pressure steam and for compressed air service. Cutaways, diagrams, capacity charts, component parts, typical applications in 10-page bulletin 301. Illinois Engineering Co, 2035 S Racine Ave, Chicago 8, Illinois.

**40** **Industrial hose assemblies,** couplings, stems, swivels and accessories described in 24-page bulletin 55. Photos, specs, engr data. J N Fauver Co, 49 W Hancock Ave, Detroit 1, Mich.

**41** **Rubber expansion joints** for relieving stresses in piping, absorbing vibration, eliminating noise. Illustrated 8-page catalog AD-137. The Garlock Packing Co, Palmyra, N. Y.

**42** **Nylon pressure tubing** for air, process, coolant, fuel and oil, lubricant, and hydraulic lines. Illustrated 6-page bulletin. The Polymer Corp of Pennsylvania, Reading, Pa.

**43** **Piston-ring expansion joints** that can be unpacked and repacked at full operating pressure, are described in illustrated 4-page bulletin 541. ADSCO Industries Inc, North Tonawanda, New York.

**44** **Hexagon nuts** Complete engineering data presented in illustrated 24-page bulletin. Includes manufacturing techniques and proper installation methods. National Machine Products Co, 44225 Utica Road, Utica, Michigan.

### PRIME MOVERS and ACCESSORIES

**45** **Fully supercharged generator.** Test performance data contained

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## but you've got to control the oil feed

## and Petro does this superlatively well without complicated gadgets

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2. Oil is thin enough for extremely fine atomization.
3. Hot oil ignites easily.
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**No manual attention is required**

The entire operation is automatic. There are no involved mechanical controls requiring adjustment or maintenance.

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CENTRIFUGES
FILTERS and STRAINERS
PUMPS, INSTRUMENTS, SPECIALTIES


## More FREE BULLETINS

Begins on page 167

in illustrated 8-page bulletin 05R8234. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wisconsin.

**46** **Steam turbines.** Single-stage units with steel casing described in 8-page bulletin 1954C. Cutaways, photos, dimensions, typical installations. Worthington Corp, Harrison, N. J.

**47** **Diesel engines** using oil, oil and gas, dual fuel and spark ignition gas are available in from 550 to 2200 hp. Photos, schematic drawings, full specs in 8-page bulletin S-500-B52B. Worthington Corp, Harrison, N. J.

### PUMPS

**48** **Double-suction pumps** for air conditioning and other general applications. Available in 5 sizes ranging from 3x2½ in., 1750 rpm, at 150-ft head to 6x6 in., at 100-ft head. Construction features, cutaways in 4-page bulletin 08B8233. Allis-Chalmers Manufacturing Co, Milwaukee 1, Wisconsin.

**49** **Rotary hand pumps** described in illustrated 4-page bulletin 330. Contains data on basic pump styles and accessories for various applications. Blackmer Pump Co, 1809 Century, SW, Grand Rapids 9, Michigan.

**50** **High vacuum pumps** Cutaway, performance curves, capacities, dimensions and weights in 4-page bulletin 400. Kinney Manufacturing div, The New York Air Brake Co, Boston 30, Massachusetts.

**51** **Rotary pumps** for pressures from 60 to 1000 psi. Photos, capacities, dimensions, construction features in 8-page bulletin 955. Geo D Roper Corp, Rockford, Illinois.

**52** **Centrifugal pumps.** Self-priming units for both flooded suction and suction lift operation described in bulletin G-1. Contains photos, cutaways, installation and operating data. The LaBour Co, Inc, Elkhart, Indiana.

**53** **Double pumps** with valve panels described in illustrated 4-page bulletin DP-308. Unit consists of 2 standard, 3000 psi pumping cartridge assemblies within a single housing. The Dudco div, New York Air Brake Co, 1700 E Nine Mile Rd, Hazel Park, Michigan.

### WATER TREATMENT

**54** **Zeolite water softeners** described in 20-page bulletin 2386-A. Specs, operating characteristics and typical installation photos. The Permutit Co, 330 W 42nd St, New York 36, New York.

**55** **"Steam purity"** is subject of 6-page pocket-size folder describing the dangers of steam contamination and how to prevent or correct them. Hall Laboratories, Inc, 323 4th Ave, Pittsburgh 22, Pennsylvania.

### WELDING

**57** **New welding process.** Performance and applications of consumable electrode inert gas welding process are given in illustrated 8-page booklet B-6525. Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.

**58** **Brazing methods** for joining metals using silver alloys and filler metals, fluxes, and gas atmospheres, is primary concern of 24-page manual 925. Includes tables, drawings, photos. Air Reduction Sales Co, 60 E 42nd St, New York 17, New York.

### MISCELLANEOUS

**60** **"Useful tables** of weights and measures"—a 92-page pocket-size manual. Mesta Machine Co, PO Box 1466, Pittsburgh, Pennsylvania.

**61** **Ductile iron.** Illustrated 20-page bulletin DI-35 contains case histories and specs for 7 main types of ductile irons and charts comparing mechanical properties. The International Nickel Co, Inc, 67 Wall St, New York 5, New York.

*Solar is building these convoluted couplings for a nuclear process installation.*

*All of Solar's U-span bellows are made to conform with API and ASME codes.*

# *Solar makes both!*

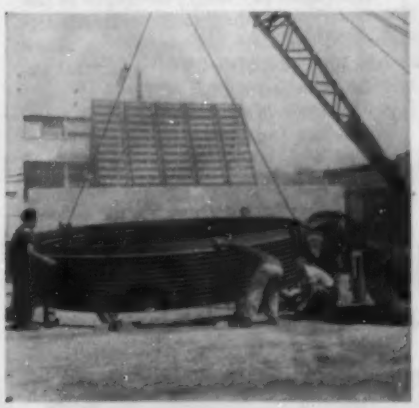
## *Convoluted and U-span expansion joints to meet any requirement*

**YOU'RE SURE TO GET** the right type of expansion joint from Solar. Sola-Flex U-span joints are designed for heavy industrial use, where extreme ruggedness is needed. In low pressure applications where lighter construction is often preferred Sola-Flex convoluted bellows are available in a variety of sizes.

This versatility — plus Solar's high standards of engineering and manufacture — means that you can depend on Solar for joints that are durable, economical, and custom-designed to fit your need.

Both standard expansion joints, and special designs, are described in Sola-Flex catalogues. For unusual applications, experienced Solar engineering teams are available for advice. Bring your problems of pressure and temperature to Solar — you're sure to get the right solution!

*Solar has built the world's largest expansion joints for a government-sponsored research project.*



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DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS

## This is What Solar Offers You

*When heat, corrosion or difficult specifications are problems, Solar can help you solve them. Solar specializes in the manufacture of precision products from alloys and special metals for severe service. Solar's experience since 1927 is unduplicated in this field.*

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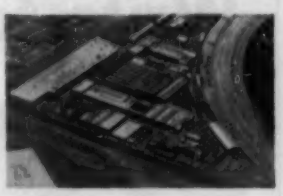
**Gas Turbines.** *Solar "Mars" 50 hp engines for auxiliary generator sets, ground carts, portable fire pumps; Solar "Jupiter" 500 hp engines in variable and constant speed models.*

**Bellows.** *"Sola-Flex"® bellows and expansion joints in many designs from ½ in up to the world's largest, 28 ft in diameter.*

**Controls.** *Complete control systems utilizing the new Solar "Microjet"® principle for control of gas turbines, jet engines and pneumatic devices.*

**CONTRACT PRODUCTION**

*Current orders include aircraft engine and airframe parts, pneumatic ducting, atomic energy components. Customers include the finest aircraft and industrial companies in the U.S. and Europe.*



**Plants.** *In San Diego (photograph above) and Des Moines. A total of 1,400,000 sq ft of floor space. Approximately 5,000 employees. Annual sales over $65,000,000.*

**Services.** *Research, design, development and production engineering staffs. Experienced with all alloy steels, stainless alloys, super alloys, and titanium and its alloys.*

**Facilities** *. . . for all types of metal fabrication—forming, machining, welding, brazing, casting, coating. Equipped for prototype, limited or mass production. Extensive laboratories. Complete quality control.*

**INFORMATION**

*For more information regarding any Solar product or service listed above, write Solar Aircraft Company Department B-13 San Diego 12, California*

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**BLACKMER rotary pumps**

- Self-adjusting for wear vane construction
- Capacity — 5 to 1500 gallons per minute
- Easy-to-replace vanes and liners
- Self-priming with high suction lift
- Wide range of applications
- Compact design

liquid materials handling ®

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Industrial, Hand and Truck Pumps, Strainers, Pressure Control Valves

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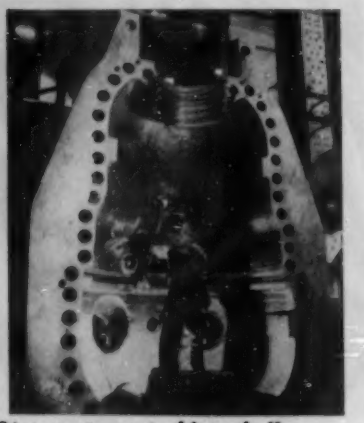
## More POWER NEWS

*Begins on page 152*



### 26-ton steam turbine shell part of 208,000 kw unit

► GIANT PEAR-SHAPED steam turbine shell is shown being machined on horizontal boring mill in General Electric Co's turbine factory. Shell is more than 15-ft long and weighs over 53,000 lbs.

It is part of the fourth steam turbine-generator being manufactured for The Cleveland Electric Illuminating Co's Eastlake power plant.

The unit, consisting of a tandem-compound turbine rated 208,000 kw and a generator rated at 260,000 kva, will be one of the world's largest. The generator will be the first of its size to have liquid-cooled conductors.

### Laboratory device developed for simulating bomb blasts

► LARGEST LABORATORY DEVICE yet developed for simulating blasts from bombs, has been designed at Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

The instrument—called a "shock tube"—allows engineers to study effects of blasts without actually exploding a bomb. Having over-all length of 150 ft and a 6-ft diameter, it is considerably larger than any others developed in the country, according to Arne H Wiedermann, associate engineer in the Foundation's propulsion and structural research department.

In order to get different shock wave pressures and durations, tube was provided with interchangeable sections of varying lengths. To absorb maximum recoil force of 600,000 lbs, foundation of the tube was designed as a slab of reinforced concrete 10-ft wide, 3 to 4-ft thick, and 100-ft long with keys 10-ft wide and 6-ft deep spaced 20-ft apart.

Here's how a shock tube is used as a laboratory instrument for generating controlled shock waves: A certain amount of combustible gas is introduced

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## from the world's largest line of "Y" type strainers!

- **Largest Size Range (1/8" - 10")**
- **Largest Variety of End Connections**
- **Largest Number of Body Materials**
- **Largest Selection of Screen Materials and Perforations**

— A selection of over 150 *Standard* LESLIE Self-Cleaning Strainer Body and Screen Combinations. Sizes 1/8" to 10"

— Cast iron, Bronze, Forged Steel, Carbon Steel, Carbon-moly, Chrome-moly and Stainless Steel bodies are available from stock.

— Designed for all pressure standards up to 2500 psi and 1050° F.T.T. and 6000 psi at 100° F. Screwed, socket or butt welding ends, plain, raised face or ring-type flanges for all existing standards. Sizes 1/8" to 10".

— Protect an entire piping system with a LESLIE strainer for every phase of the process. Send for bulletin 5308 for the complete story.

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## SELF-CLEANING STRAINERS

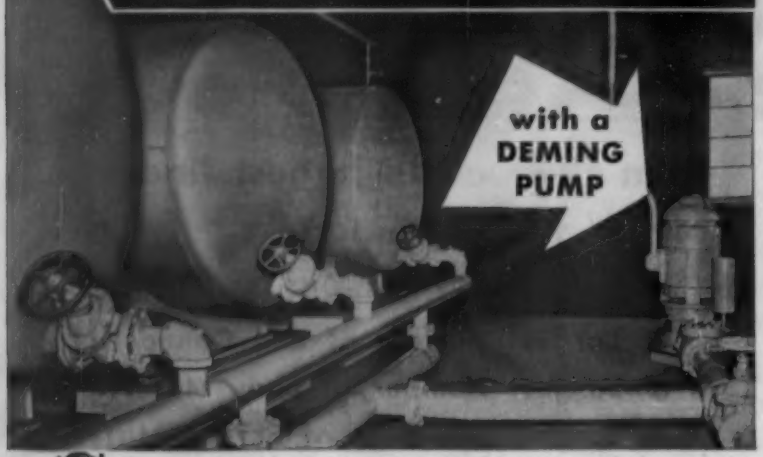
**LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY**

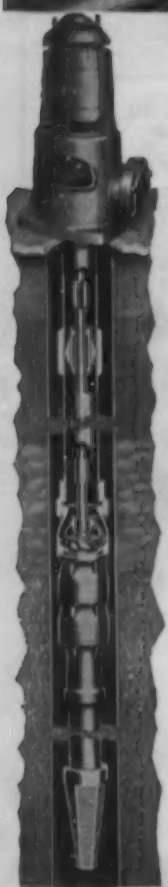
5313

"REGULATORS SINCE 1900 — STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

# STOCKPILING WATER

*Against potential shortages*



● A reserve supply of water for protection against shortage is a *"preventive form of insurance."* That and other considerations caused a midwestern manufacturer to call in a Deming Distributor for assistance in planning the company "water works" illustrated above.

Other considerations included the high cost of "city water;" the uncertainty of city supply during summer peak demands; and the need to process water in advance of its use in plant operations.

Water is pumped from a 140-ft. deep well on company property. Capacity of the Deming Vertical Turbine Pump is more than 650,000 gallons a day at 50-70 lbs. pressure. Pump is operated by a 50 H.P. motor. The three storage tanks shown in the picture have a combined capacity of 22,500 gallons.

The "pay-off" on this installation is the big reduction in water costs and the "preventive insurance" against possible stoppage of plant operations due to lack of water.

Investigate the advantages of Deming Vertical Turbine Pumps. Write for BULLETIN NO. 4700.

75th ANNIVERSARY DEMING PUMPS 1880 - 1955

**THE DEMING COMPANY**
547 BROADWAY • SALEM, OHIO


## More POWER NEWS

Begins on page 152

into one section of tube and is confined by a light diaphragm. Diaphragm is shattered when gas is ignited. Released pressure wave travels down tube to test section where a building model has been placed. Resulting forces are recorded with electronic equipment.

### 100-bhp air-cooled diesels produced in England

► AIR-COOLED DIESEL ENGINES with powers to 100 bhp have been introduced in England. Manufactured by J & H McLaren Ltd they are the first to be produced with such an extensive power range. The fact that they are air-cooled represents a considerable advance in design. Problems associated with installation of water-cooling systems are eliminated. Mechanical efficiency is increased and cylinder wear reduced because cylinder walls can be retained at a much higher temperature than is possible with water-cooled systems.

The four cycle engines, with cylinder bore of 114.3 mm and stroke of 110 mm run at 1800 rpm. Their 12 bhp per cylinder is developed with a conservate rating of 77 lbs sq in. bmep. Units are built with 2, 3, 4, 6 or 8 cylinders.

### New handbook outlines use of alloy steels

► "ALLOY STEEL PAYS OFF," is title of 200-page handbook available for general distribution. Highlighted in this book are economic advantages of fabricating with alloy steels for improved weight-to-strength ratios in aircraft construction, bridges, electrical equipment, machinery, etc. These include longer life and less maintenance, heavier payloads and lower operating costs, improved safety and over-all savings in freight and shipping costs. Advantages of high impact strength and shock-load resistance are discussed—as well as savings resulting from improved resistance to corrosion and wear.

Technical, administrative and equipment maintenance personnel wishing to obtain copies may do so by writing directly to Climax Molybdenum Co, 500 5th Ave, New York 36, New York.

(*More Power News on p 242*)

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**Here is REAL PROOF of Ric-wiL superior quality and performance... This recent installation of over 600 miles of pipeline represents a tremendous investment... and... a tremendous "vote of approval" for Ric-wiL systems.**

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RAINS MAGNIFY TURBIDITY PROBLEMS

Ferric salts have proven their ability to coagulate waters of widely varying turbidity. Spring rains increase turbidity for those who must treat surface supplies. The use of Ferri-Floc will simplify the treatment of this high turbidity. Ferri-Floc is partially hydrated Ferric Sulphate that has the ability to convert these high turbidities without radical dosage changes.

TENNESSEE CORPORATION Ferri-Floc

**Performance is Proof—**
**A large filtration plant Superintendent has this to say:**

For coagulation of high turbidity with a high PH we have found Ferric Sulphate to be superior in all cases and we would not hesitate to recommend it.

**Drop us a card for your copy of this booklet that contains valuable information for you.**

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia


## More POWER NEWS

Begins on page 152

### Calendar of Events

**May 10-11—American Institute of Electrical Engineers,** industrial heating conference. LaSalle Hotel, Chicago. Details from AIEE, 33 W 39th St, New York 18, New York.

**May 22-26—Air Pollution Control Association,** 47th annual meeting. Sheraton-Cadillac Hotel, Detroit. Details from APCA, 4400 5th Ave, Pittsburgh 13, Pa.

**May 23-25—Oil Heat Institute of America,** 1st annual commercial-industrial oil burning and equipment conference. Kellogg Center Auditorium, Michigan State College. Details from Continuing Education Service, Michigan State College, East Lansing, Michigan.

**May 30-June 10—Canadian International Trade Fair,** Toronto, Canada. Complete information from CITF, Exhibition Park, Toronto, Ontario, Canada.

**June 6-9—American Society of Mechanical Engineers,** oil and gas power division, 27th annual conference and exhibit. Hotel Statler, Washington, D.C. Theme is "Oil and gas power for national defense." Details from ASME, 29 W 39th St, New York 18, New York.

**June 7-10—American Welding Society,** national spring meeting. Hotel Muehlebach, Kansas City, Mo. To be held in conjunction with annual Welding Show at Municipal Auditorium, Kansas City, on June 8-10. Details from AWS, 33 W 39th St, New York 18, New York.

**June 13-17—The American Association for the Advancement of Science,** Gordon Research Conference on ion exchange. Full information on request to W George Parks, director, dept of chemistry, University of Rhode Island, Kingston, R. I.

**June 14-16—American Institute of Electrical Engineers,** in cooperation with American Physical Society and American Institute of Mining and Metallurgical Engineers, 1st magnetics conference and exhibition. William Penn Hotel, Pittsburgh, Pa. For information write A C Beiler, c/o Westinghouse Electric Corp, 2-F Materials Engineering dept, East Pittsburgh, Pa.

**June 20-24—American Society for Engineering Education,** 63rd annual meeting. Pennsylvania State University. Details from Prof K L Holderman, general chairman, 103 Mechanical Engineering Bldg, Pennsylvania State University, State College, Pennsylvania.

**June 26-July 1—American Society for Testing Materials,** 58th annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. Full information from ASTM, 1916 Race St, Philadelphia 3, Pennsylvania.

**June 27-29—American Nuclear Society,** 1st annual meeting. Pennsylvania


Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
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**UNIONS**
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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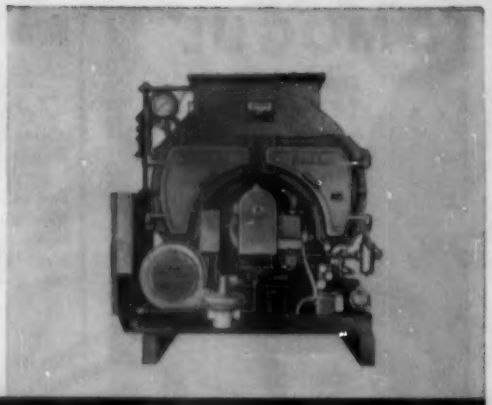

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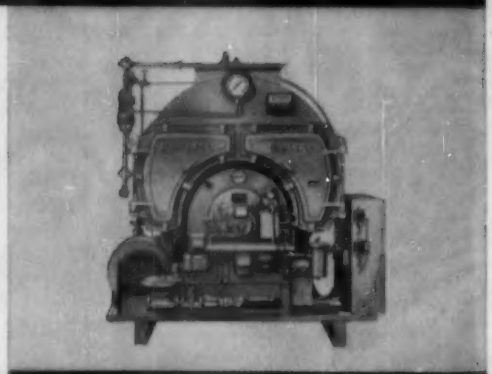
Planned as perfectly integrated units—combined for the highest in efficient performance—these 3 matched Boiler-Burner Units represent the merged knowledge, experience and judgment of experts in both boiler and burner fields. Here, truly, are 3 of the finest Boiler-Burner Units for high or low pressure heating—power and process steam—oil, gas, or oil-gas combinations. You can be sure of dependable performance from a ...



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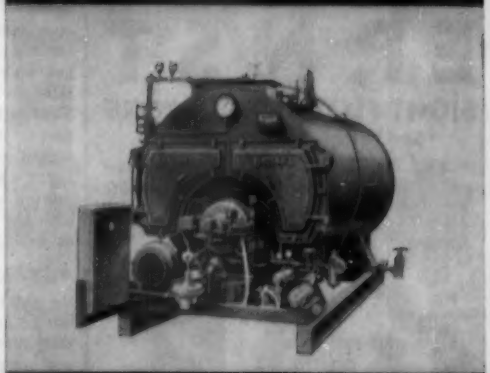
reserve + plus rated

## Boiler



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You can be sure of lower operating cost and higher efficiency. Reserve Plus Rating certifies that 50% or more power is built in to provide for piping, pickup and additional capacity requirements. It means "cruising speed" operation with extra reserve power to take care of emergencies. It means ratings based on nominal capacity, not maximum capacity.

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FIG. 29 Cylinder with Impeller

FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

All sizes up to 6"

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LIVINGSTON, N. J.


# More POWER NEWS

*Begins on page 152*

State University. Details from Prof W W Miller, Pennsylvania State University, State College, Pennsylvania.

**June 27-July 1—American Institute of Electrical Engineers,** summer general meeting. New Ocean House, Swampscott, Mass. Details from AIEE, 33 W 39th St, New York 18, New York.

## Revise methods for compiling industrial injury rates

► NEWLY-REVISED American Standards Association publication Z 16.1 outlines "Method of compiling industrial injury rates." Several important changes have been made from the previous standard issued in 1945.

Among the changes are (1) new base for computing severity rates, bringing this into line with the method for computing frequency rate, (2) new schedule of time charges for hand and foot injuries, (3) new classification of injury called, "medical treatment injury."

The standard is adopted by National Safety Council, but is independent of Workmen's Compensation Laws. For further information contact ASA, 70 E 45th St, New York 17, New York.

**New series condenser,** setting world's records for size and line voltage, has been put into use by Swedish Board of Waterfalls in powerlines from the north of Sweden to the south. This unit has an apparent power of 105,000 kva and is designed for service voltage of 380,000 v. Large size and capacity mean savings in powerline construction, since four lines with the condenser carry as much current as five lines without.

**Newly formed** refrigeration division marks the entry of Perfex Corp into the field of refrigeration and air conditioning. The company will manufacture condenser and evaporator coils. Fabricated to specification, capacity ratings range from 1/3 to 3 hp for room and automotive air conditioners, and 2 to 10 tons for residential and self-contained applications.

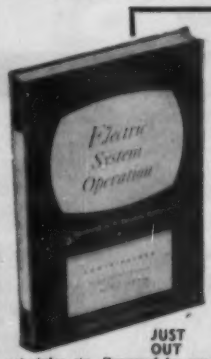
## 1955 AWARD PROGRAM

**Have you recently modernized any of your power services? Tell us about it. You may be in the 1955 award picture. See p 99**

JUST OUT

**ELECTRIC TRANSMISSION AND DISTRIBUTION**

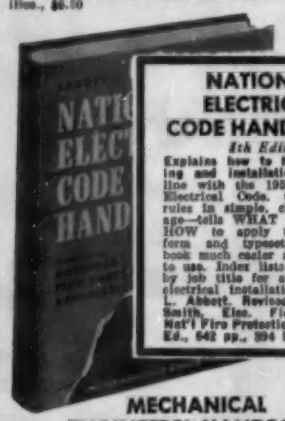
Describes simply and clearly the equipment used in transmission and distribution of electric energy from generating station to consumer, including overhead and underground circuits, high and low voltage circuits, protection against short circuits and lightning, and street lighting. Explains actual layout of equipment and what it does in the system. Prepared by specialists under editorship of B. G. A. Skrotzki, Assoc. Ed., POWER. 466 pp., 291 illus., $7.50



JUST OUT

**ELECTRIC SYSTEM OPERATION**

Describes in detail the operation of generating, transmitting, and distribution equipment covering the major problems in running an electric system safely and economically. Reviews electric utility system from fuel input and water flow to customer's connections. Shows operations involved in scheduling and maintaining equipment. Gives data on relays, load dispatching and control, system communications, operating costs and rate schedules etc. Prepared by specialists under editorship of B. G. A. Skrotzki, Assoc. Ed. POWER. 370 pp., 276 illus., $6.50



JUST OUT

**NATIONAL ELECTRICAL CODE HANDBOOK**

*8th Edition*

Explains how to handle wiring and installation jobs in line with the 1953 National Electrical Code. Gives code rules in simple, clear language—tells WHAT they mean, HOW to apply them. New form and typesetting make book much easier and quicker to use. Index lists code rules by job title for all types of electrical installation. By A. L. Abbott. Revised by G. L. Smith, Elec. Field Engr., Nat'l Fire Protection Assn. 8th Ed., 642 pp., 894 illus., $7.50

**MECHANICAL ENGINEERS' HANDBOOK**

Provides practical data on every branch of mechanical engineering—from aeronautics to mechanical refrigeration, from power generation to welding, from metal-cutting to hoisting and conveying. New materials in the 5th edition include fluid mechanics, aircraft jet propulsion, plastics, industrial supersonics, rocket fuels, and many more. Edited by Lionel S. Marks, Gordon McKay Prof. of Mech. Eng., Emeritus, Harvard Univ. 5th Ed., over 2200 pages, 1900 illus., $15.00

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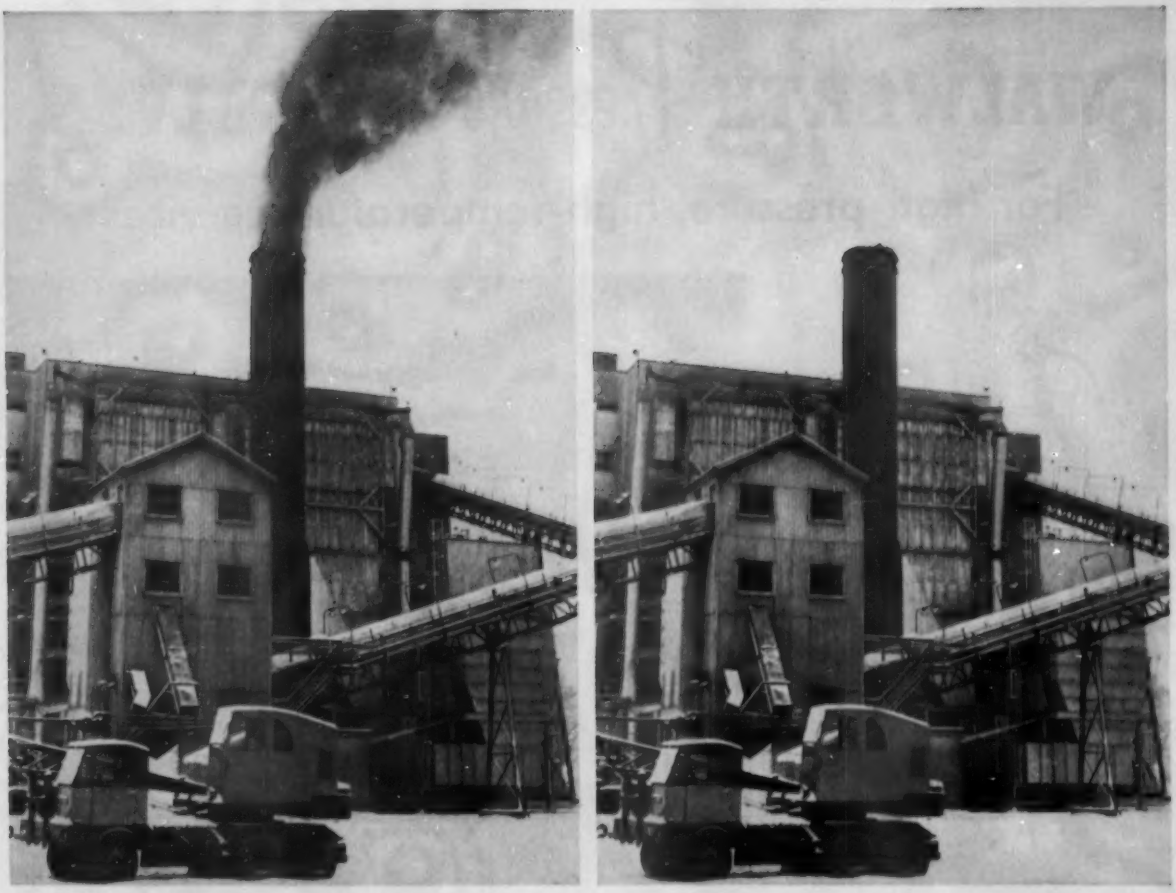

# Fly Ash Problem Solved By Central Station

This Pennsylvania utility felt that as long as you can *see* dirty stack discharge, you have a problem. To solve it, they decided to insist on fly ash collection equipment with very high efficiency.

The electrical precipitators they chose, which were placed after existing mechanical collectors, are Cottrells, designed and built by Research-Cottrell. Their effectiveness is demonstrated in the above unretouched photographs. At the left, the precipitators were turned off long enough to take the picture showing the volume of fly ash discharged by the boilers. At the right, the precipitators are turned back on. Stack discharge is visually clean.

This is another example of industry's trend toward establishing its own higher standards for nuisance abatement. Research-Cottrell, which has made more fly ash installations than any other company, cites the following comparison:

In the period from 1923 to 1939 only 11% of its power plant customers specified fly ash collection efficiency of 95 to 98%. In recent years, that 11% has risen to fully 90%.

One reason, of course, is the generally increasing emphasis on community relations. Another factor is that farsighted companies are anticipating stricter smoke regulations. They are anxious to install equipment that will end their smoke problems now and also prevent such problems from occurring in the future.

Still another factor is this. In recent years, with modern coal pulverization and advanced boiler design, there has been an increase in the fineness of fly ash particles. This calls for the most efficient equipment available.

Read—in Bulletins FA and MI—about Cottrell equipment and the Research-Cottrell's MI Rapper. This device eliminates rapping puffs and enables the precipitator to maintain, continuously, its high collection efficiency. Write for your copies today.

RC-183

**RESEARCH-COTTRELL, INC.**

A WHOLLY OWNED SUBSIDIARY OF RESEARCH CORPORATION

*Main Office and Plant: Bound Brook, N. J.*

*405 Lexington Ave., New York 17, N. Y. • Grant Building, Pittsburgh 19, Pa.*

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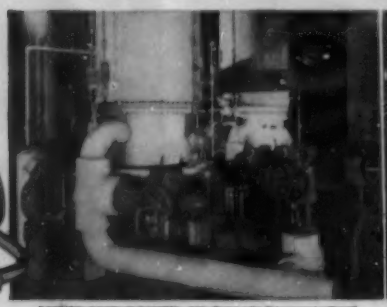
# WALWORTH *Pressure-Seal* VALVES

## For high-pressure, high-temperature services

Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.

MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"—largest Great Lakes ore carrier.



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Series 600 Pressure-Seal Y-Globe Non-Return Valves and Series 600 Pressure-Seal Gate Valve.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

***SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE***

**Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.**

# WALWORTH

**valves • fittings • pipe wrenches**

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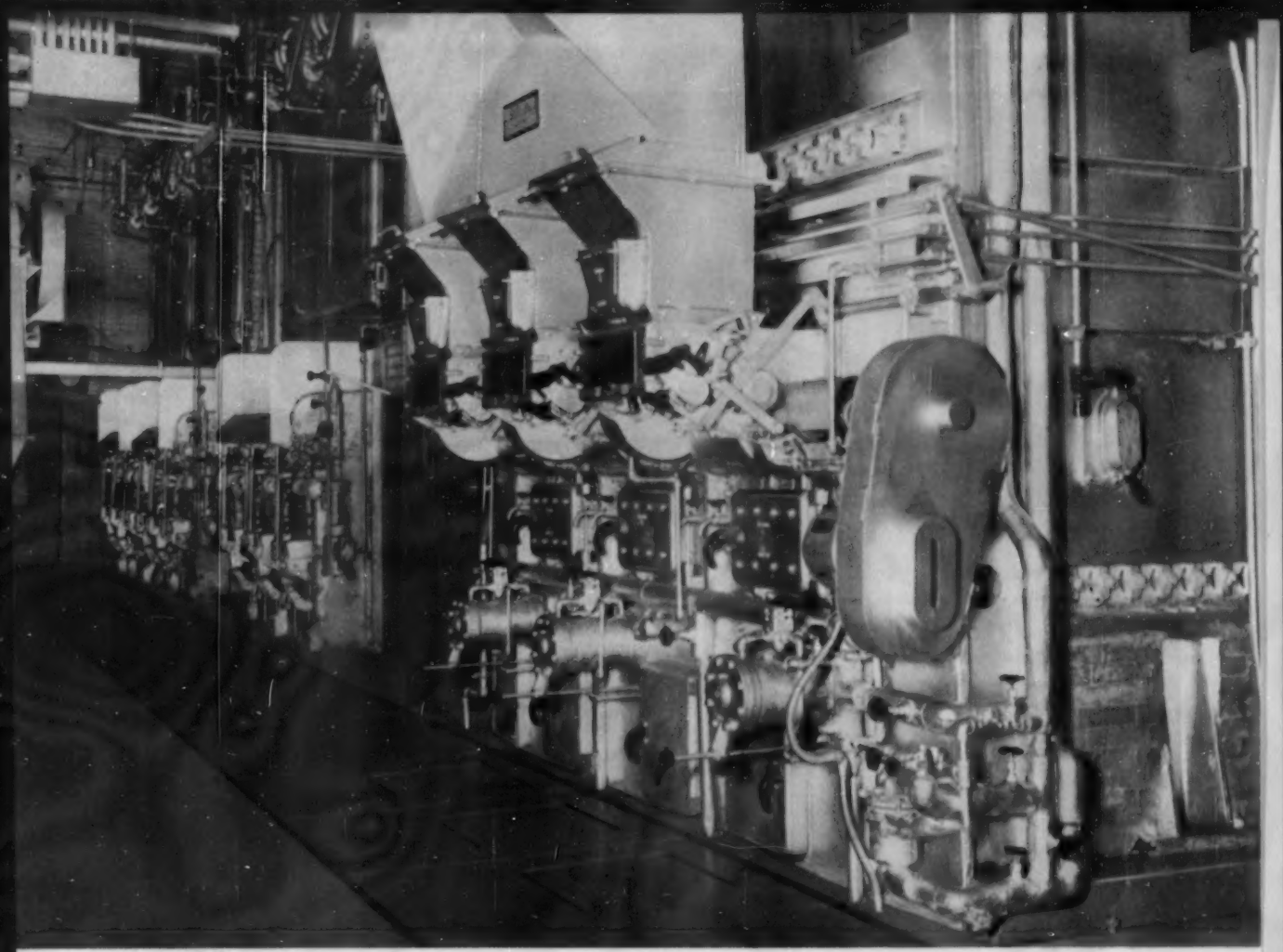


# For efficiency and economy of operation, Liggett & Myers burns coal the modern way

In 1952, the steam demand of the Liggett & Myers Tobacco Co., Richmond, Va., had developed to the point where additional capacity was needed. The firm of Lockwood Greene Engineers, Inc., retained by Liggett & Myers to study the situation, recommended installing modern, automatic coal burning equipment to operate in conjunction with the original boilers. The equipment was installed.

The results have been extremely gratifying. The boiler plant now maintains constant pressure under high steam demand, the steam coal rate has increased 4.1 and there have been no operating difficulties. In addition, other benefits include reduction of labor, satisfactory air pollution control and improved performance records.

## Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

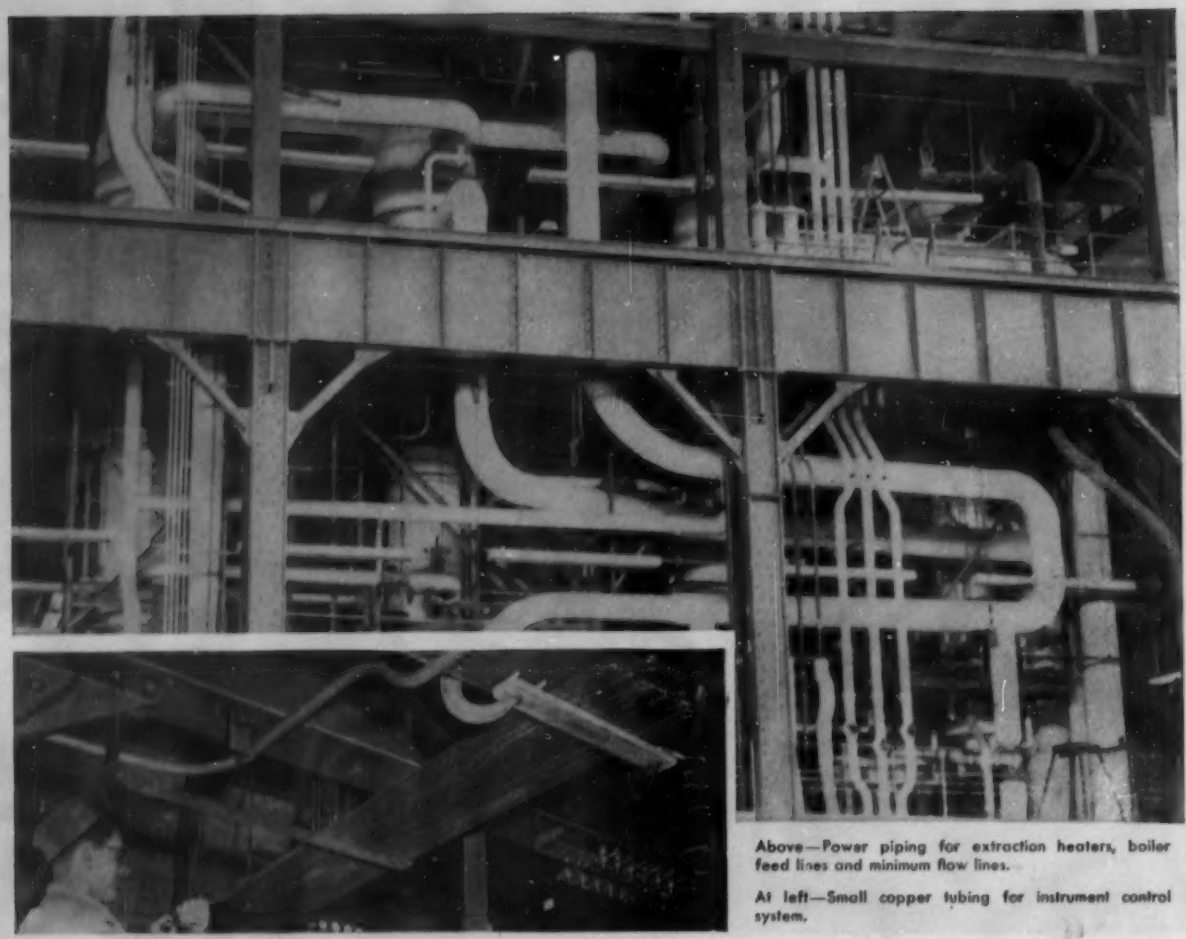
Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.



Above—Power piping for extraction heaters, boiler feed lines and minimum flow lines.

At left—Small copper tubing for instrument control system.

# over 47 miles of BLAW-KNOX piping installed in Georgia Power's Plant Hammond

*To get more information on piping for industry, send for your copy of Bulletin No. 2443*

When the Georgia Power Company's new 300,000-kw Plant Hammond at Rome, Georgia, is completed this summer, it will have 250,000 feet of piping, ranging in sizes from ¼ inch to 24 inches . . . all of it fabricated and erected by the Power Piping Division of Blaw-Knox.

More than 50,000 feet of power piping 2½" and larger were shop fabricated in Pittsburgh. Steam pressures up to 2000 psi and up to 1000°F are carried by this piping.

About 200,000 feet of smaller sizes were field fabricated at the site . . . one-half of which was copper tubing used on control room instrumentation.

Always available to you through our Power Piping Division are the same experience, skill and facilities which were put to work on this extensive and intricate piping system for Georgia Power. Just let us know your requirements and we'll provide the service you need.

**BLAW-KNOX COMPANY**

**POWER PIPING AND SPRINKLER DIVISION**

**PITTSBURGH 33, PENNSYLVANIA**

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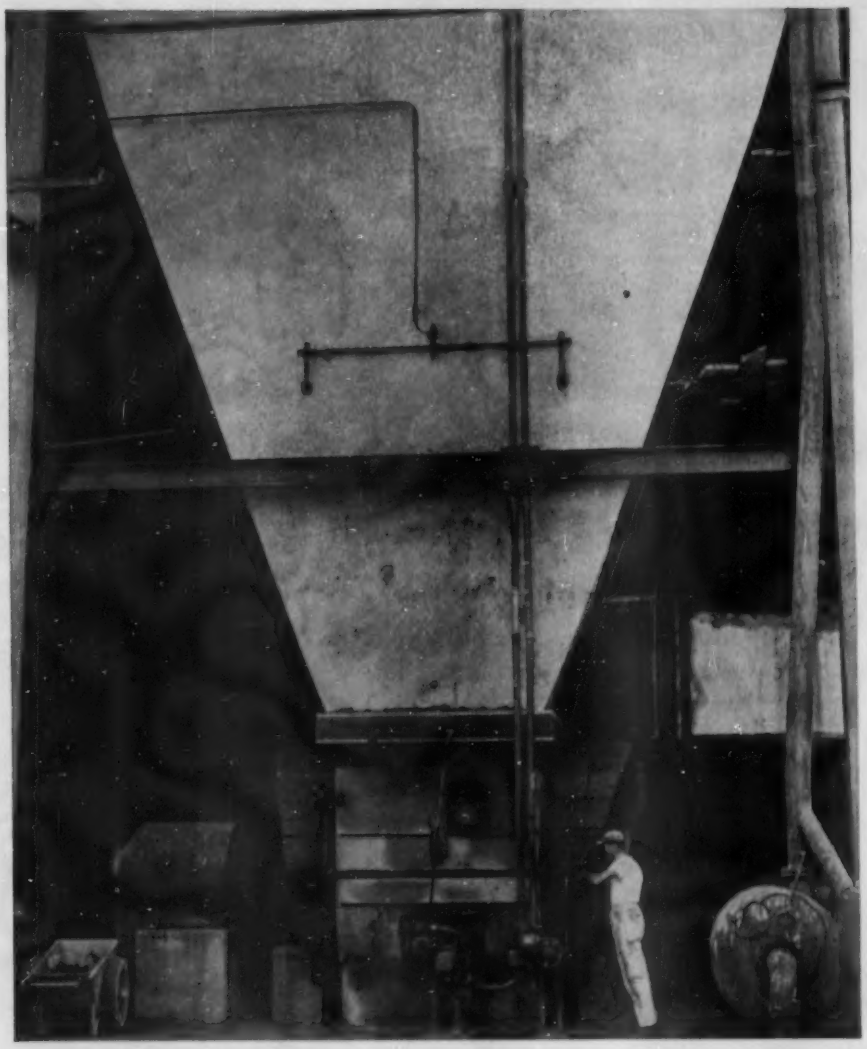
## POWER PIPING

Complete prefabricated piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • constant support spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

BALDWIN-HILL

# *Super* POWERHOUSE CEMENT.....



# NOW IS.... WHITE

Forced Draft Duct, Fan to Air Heater insulated with B-H Mono-Block, finished with 3/16" B-H SUPER POWERHOUSE CEMENT

Made from the new Baldwin-Hill Spun Mineral Wool fibers, Super Powerhouse Cement dries out *white* to give you a better, more pleasing finish coat. And remember, it requires only one-coat application because it *insulates* as it *finishes*.

**BALDWIN-HILL**
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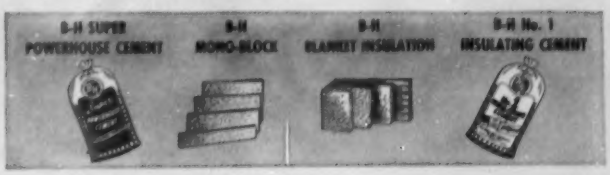

# Two Terry Turbines equipped with "trouble eliminators"

Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

**THE TERRY STEAM TURBINE CO.**

TERRY SQUARE, HARTFORD 1, CONN.

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TT-1199

# Now—CORROSION PROTECTION at a BUDGET PRICE

● Here is a deaerator of Schaub quality, engineered on new principles, designed especially to put effective boiler feed water deaeration within price reach of the small to medium size plant.

These plants, from 3,000 to 30,000 lbs/hr., often running at low pressure, are likely to have the same corrosion and high maintenance costs as their "big brothers". In fact, "Return Line Corrosion" is *most apt* to occur in *low pressure* heating systems even though raw water make up is negligible. For such plants, as well as for high pressure installations, the Schaub .03 Deaerator offers an effective and economical solution that will pay for itself many times over.

The Schaub .03 Deaerator operates *fully vented* at atmospheric pressure. Premium cost construction is eliminated, maintenance and operating costs are reduced to a minimum. Liberated, non-condensible gases escape *immediately* and *completely*. At the same time, simple but effective spray-contact vent condensing, prevents wasteful steam vapor loss. Pin-point temperature control, "live-action" heating and rust-proof chromasoid lining are exclusive features.

**FRED H. SCHAUB ENGINEERING COMPANY**

**2105 South Marshall Boulevard • Chicago 23, Illinois**

***Get the Full Story on This More Efficient Low Cost Deaerator — Write for Bulletin 1300***

**Simple though it is, there's much more to the Schaub .03 Deaerator than can be told here. Bulletin 1300 is filled with information for the operating or consulting engineer responsible for economical and efficient deaeration of boiler feedwater. Tells the "hows" and "whys" of deaeration, especially for the small to medium size plant, explains how the Schaub method differs and its advantages in performance and low cost. Mail the coupon today.**

**NOTE:** The Schaub .03 Deaerator is designed for boilers up to 30,000 lbs. per hour. For capacities up to 100,000 lbs. per hour at .005 cc/liter "zero-oxygen" removal write for Bulletin 575, describing the Schaub Zero-Oxygen Deaerator.

**FRED H. SCHAUB ENGINEERING COMPANY**
**2105 South Marshall Blvd., Chicago 23, Illinois**

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....ZONE....STATE.....

Coal enters conveyor system at far left and moves to crusher house before going on to bunkers or to outdoor storage.

Traveling belt tripper over bunker discharges through Zipper bunker seal. Dust cannot escape since bunker is open only under discharge chutes.

# Dockside to Bunkers

## ...This Coal Handling System is Engineered to Eliminate Emergencies

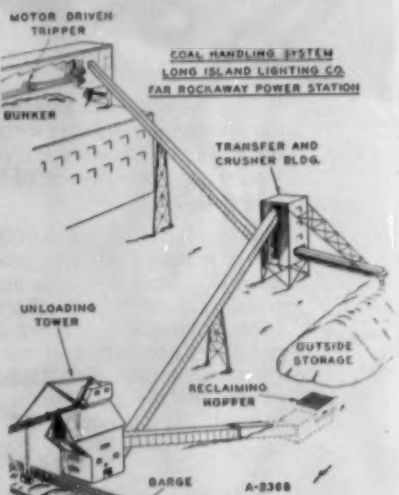
At the *Long Island Lighting Company's* new generating station at Far Rockaway, every facility has been planned to make sure that no forseeable emergency will interfere with power production. This includes the coal handling system engineered by Stephens-Adamson.

The complete system takes coal from dockside, crushes it, carries it to bunkers or stocks out for later reclaiming. It puts coal where it is needed—when it is needed—with a minimum of supervision.

In such an extensive system, skillful engineering plans to eliminate emergencies so that coal will keep moving without slow-ups or jam-ups. Thus, before coal ever enters the crusher, magnetic separators remove any tramp iron. Coal is weighed "on the run" as it travels on the 300 TPH belt conveyor to the crusher. After crushing, coal moves to bunkers or is shunted on an 80-ft. boom conveyor to storage. Coal going to bunkers is discharged through zipper seals that open and close like a slide fastener to prevent escape of dust.

To make certain that belt reversal cannot endanger or shut down the system, inclined conveyors are protected by S-A "no-roll" Hold-Backs on the head shafts. S-A spring type Belt Cleaners keep belt clean to prolong dependable service life. S-A "Pacific" belt conveyor carriers insure easy lubrication and long uninterrupted service.

In all details, this S-A coal handling system has been engineered to provide a continuous flow of coal with minimum maintenance, supervision or replacement. It is a good example of the thorough S-A engineering available to you. Write for a free survey and recommendations on a system to meet your needs for low cost coal handling for any conditions, any volume.




Sketch shows complete coal handling system at Long Island Lighting Company's new Far Rockaway Steam Electric Station. Conveyor system handles 300-tons per hour in 36-inch belts.


SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

**STEPHENS-ADAMSON MFG. CO.**

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**Engineering Division**
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A complete line of conveyor accessories including centrifugal loaders — car pullers — bin level controls — etc.

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A complete line of industrial ball bearing units available in both standard and special housings.

*This*

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***provides economical solutions to every industrial water treatment problem***

ENGINEERS and consultants helped prepare this new Bulletin No. 953 . . . "Controlled Volume Pumps for Water Treating Systems."

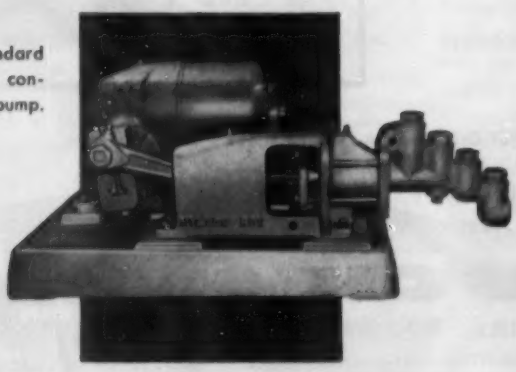
It has been termed, "a most important contribution to water treating literature."

Over fifty illustrations are used in this first-of-its-kind Bulletin, to describe and picture:

- Controlled Volume Pumps and how they work.
- Actual applications in all phases of industrial water treating.
- Basic and advanced system design.

Send for your free copy today . . . on your company letterhead, please!

For specific recommendations on water treatment problems, see your consulting specialist. For reliable, accurate flow control of water treating chemicals, see Milton Roy Company, Manufacturing Engineers, 1300 East Mermaid Lane, Philadelphia 18, Pa.



Milton Roy standard motor-driven controlled volume pump.

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*Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America, and Africa.*

SAVE MONEY AND PROTECT YOUR PLANT BY

# Installing Hancock 1500# and 2500# Steel Valves and assuring dependable leak-proof service

Put an end to the costly hazards of valve leakage in your high-pressure, high-temperature steam plant! Let proved-in-the-line Hancock 1500# and 2500# Valves assure the safe, reliable performance so essential to protect personnel, plant and service to customers.

Hancock 1500# and 2500# Steel Valves are preferred by most design and operating engineers in modern steam plants for very practical reasons. There is no bonnet joint to leak, no gasket to leak, no seat insert to leak! In fact, these rugged valves have every design, quality and construction feature essential for the severest services. Get complete information, then try one of these heavy-duty valves. You will soon agree that . . .

**When Hancocks go in, valve costs go down!**

**SIZES:**

¼" through 2"
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and Yoke

**SERVICE RATINGS:**

**Screwed and Socket Weld Ends:** For all pressures up to 2500 psi at 1050° F., O.W.G. 6000 psi—100° F.

**Flanged Ends:** For all pressures up to 1500 psi at 900° F., O.W.G. 3600 psi—100° F.

**YOUR INDUSTRIAL SUPPLY DISTRIBUTOR** is as close as your telephone. You can depend on his recommendations and service to save you time, trouble and expense.

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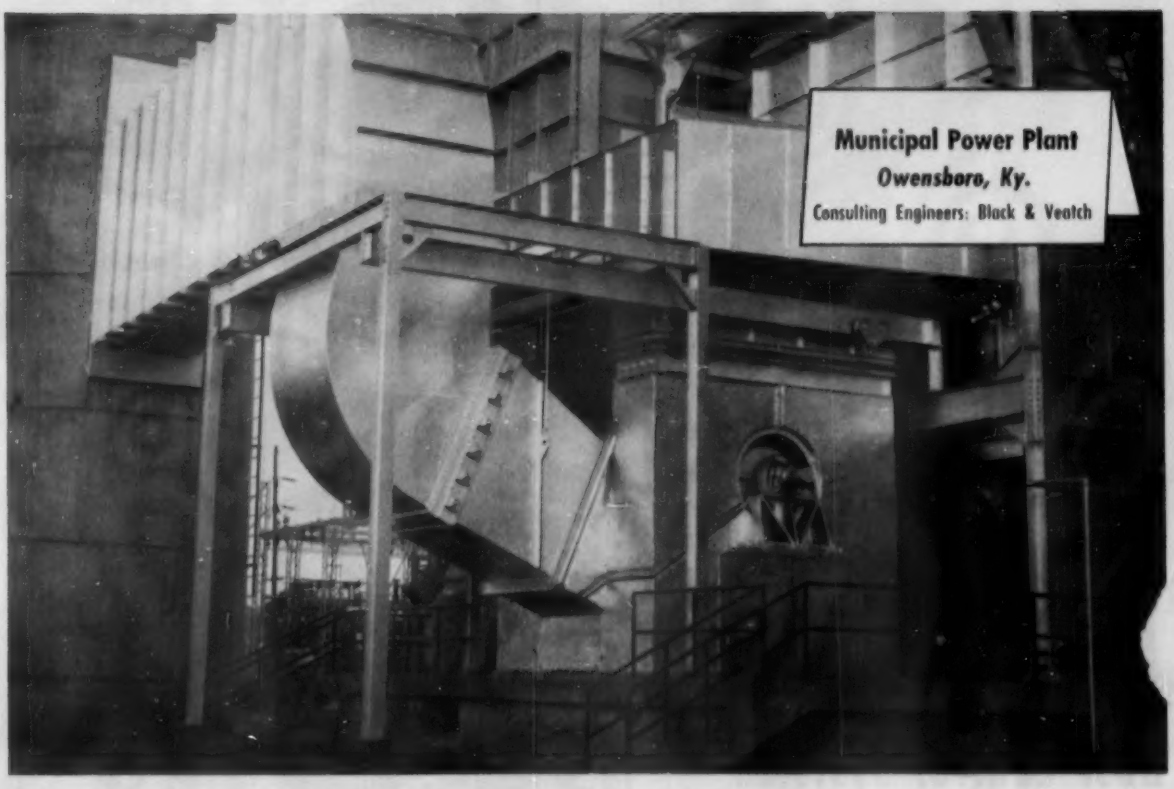
A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, Stratford, Conn. 'CONSOLIDATED' SAFETY RELIEF VALVES, Tulsa, Okla. AIRCRAFT CONTROL PRODUCTS, Danbury, Conn. and Inglewood, Calif. "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, Muskegon, Mich.

# Here's still another...




# ...new Municipal Power Plant using CLARAGE Fans!

● Serving the City of Owensboro, Kentucky, is this new addition to its power plant on the Ohio River.

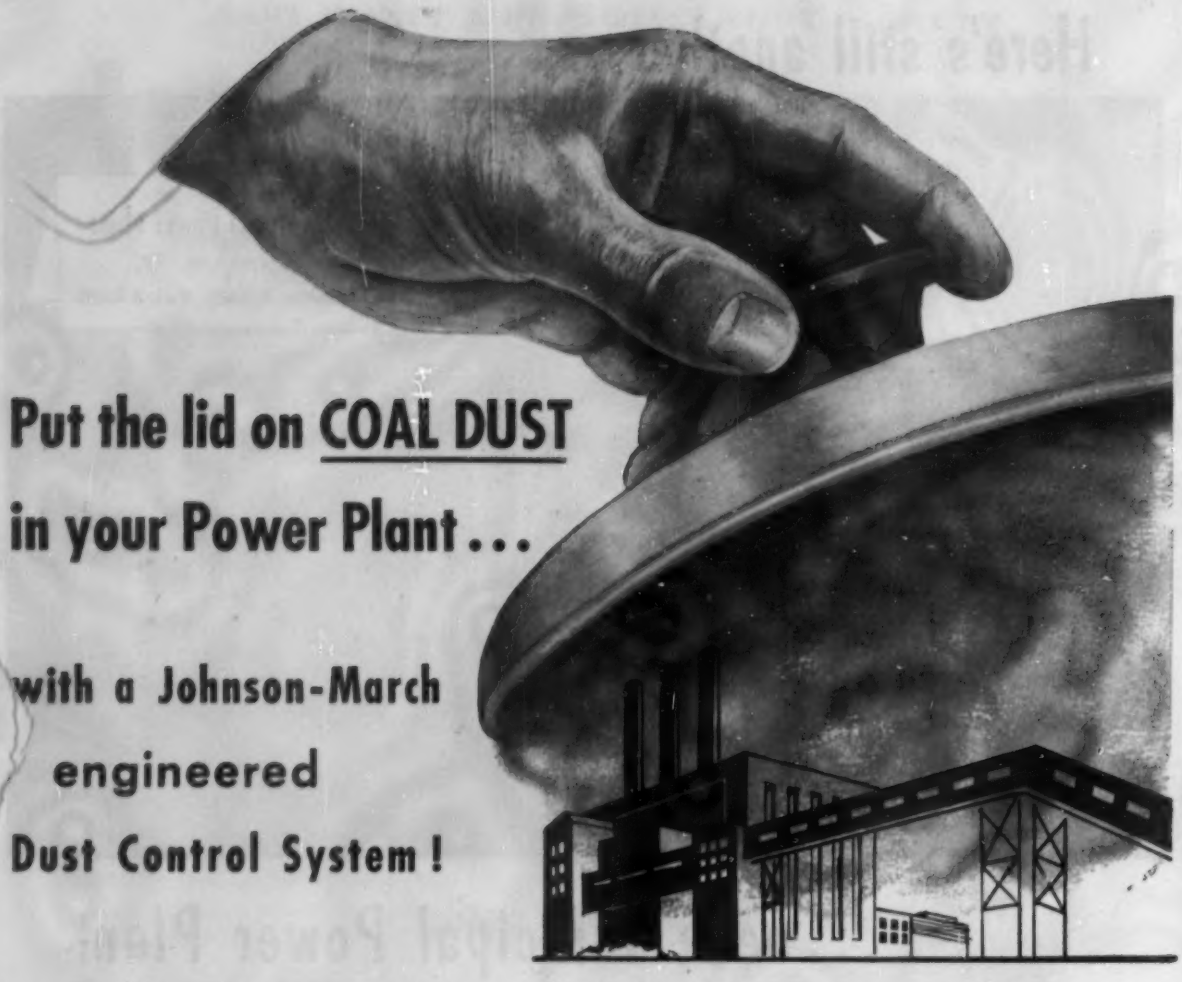
Reported to be the largest and most efficient boiler installation in a municipal power plant east of California, it like so many others across the nation is Clarage equipped.

Forced draft is furnished by a Clarage Type W, Class IV fan delivering 108,000 CFM at 12.8" SP; induced draft by a Clarage Type RT fan, provided with shut-off type inlet dampers and an adjustable speed magnetic drive, which delivers 130,000 CFM at 12.2" SP.

Power plant people know that Clarage mechanical draft equipment on the job means satisfaction with the job. And this point has been PROVED in countless installations where Clarage fans have been giving economical, uninterrupted service for 30 years and longer. **CLARAGE FAN COMPANY, Kalamazoo, Michigan.**

You can Rely on **CLARAGE** ...dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES ● IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



# Put the lid on COAL DUST in your Power Plant...

## with a Johnson-March engineered Dust Control System!

Here's the simplest, most economical way you can stop dust in your power plant. A Johnson-March engineered dust control system stops coal dust wherever it occurs—at car dumpers, crushers, hoppers, belt galleries and coal piles... as well as dust created in fly ash handling and disposal.

Low-cost liquid dust control systems require almost no maintenance—cost only 1/10 as much as most other dust handling systems. No costly ducts, hoods or fans to interfere with normal operations.

Join the many leading power plants that have solved maintenance problems due to coal dust... fire and explosion hazards... community dust nuisance problems... safety hazards... with economical Johnson-March engineered dust control systems.

Even if you now have a mechanical dust collection system, let Johnson-March engineers show you how it can be improved at low cost. For a fast, sure solution to your plant and community dust problems, fill in and mail this coupon today.

THE JOHNSON-MARCH CORP. P
1724 Chestnut St., Philadelphia 3, Pa.
At no obligation, please

☐ Send informative data on J-M dust control systems.
☐ Have an engineer analyze our dust problem at no obligation.

NAME..... TITLE.....
COMPANY.....
ADDRESS.....
CITY..... STATE.....

**Johnson March**

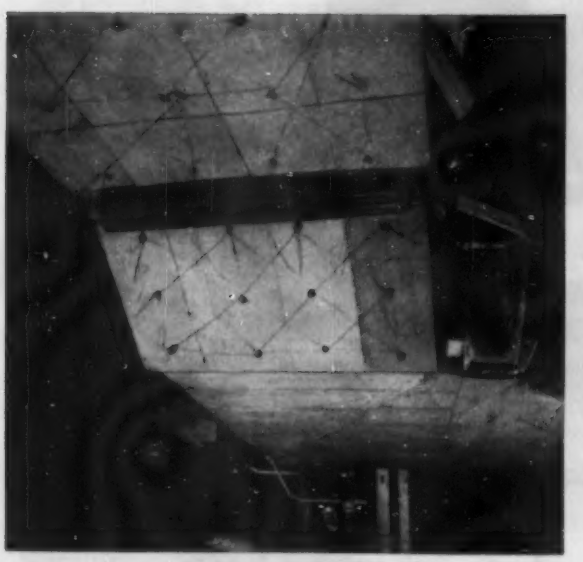
*Dust Control Engineers*

**1724 CHESTNUT STREET, PHILADELPHIA 3, PA.**

CANADIAN REPRESENTATIVES: G. F. Sterne & Sons, Ltd., Brantford, Ontario

# EAGLE-PICHER
# PV SUPERTEMP
# BLOCK INSULATION

## with the NEW *"Precision-Finish"*



**A TRUE-CUT BLOCK!** Eagle-Picher's new "precision-finish" is one of the most important insulation developments in years. Here's a highly efficient, all-purpose insulating block that is practically dustless.

**GREAT STRUCTURAL STRENGTH!** Eagle-Picher PV Supertemp Block meets your specific demands for long-lasting insulating block able to withstand a wide hot surface temperature range up to 1900 F. PV Block effectively resists steam and other moisture, does not disintegrate or lose thermal efficiency under heavy-duty service.

**EASILY INSTALLED!** Lightweight PV Supertemp Block is easy to handle, requires only minimum reinforcing. It is easily cut to fit irregular areas—and no special tools are needed.

***WRITE FOR FREE SAMPLE TODAY!***

Compare Eagle-Picher PV Supertemp Block with other insulating blocks. You'll appreciate the improved temperature control that pays off in greater fuel savings. You'll sell yourself on the new "precision-finish"!

*Since 1843*

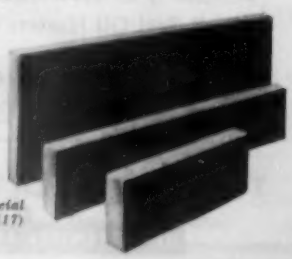
EAGLE EP PICHER

**THE EAGLE-PICHER COMPANY**

Producing a complete line of industrial insulations

**Cincinnati 1, Ohio**

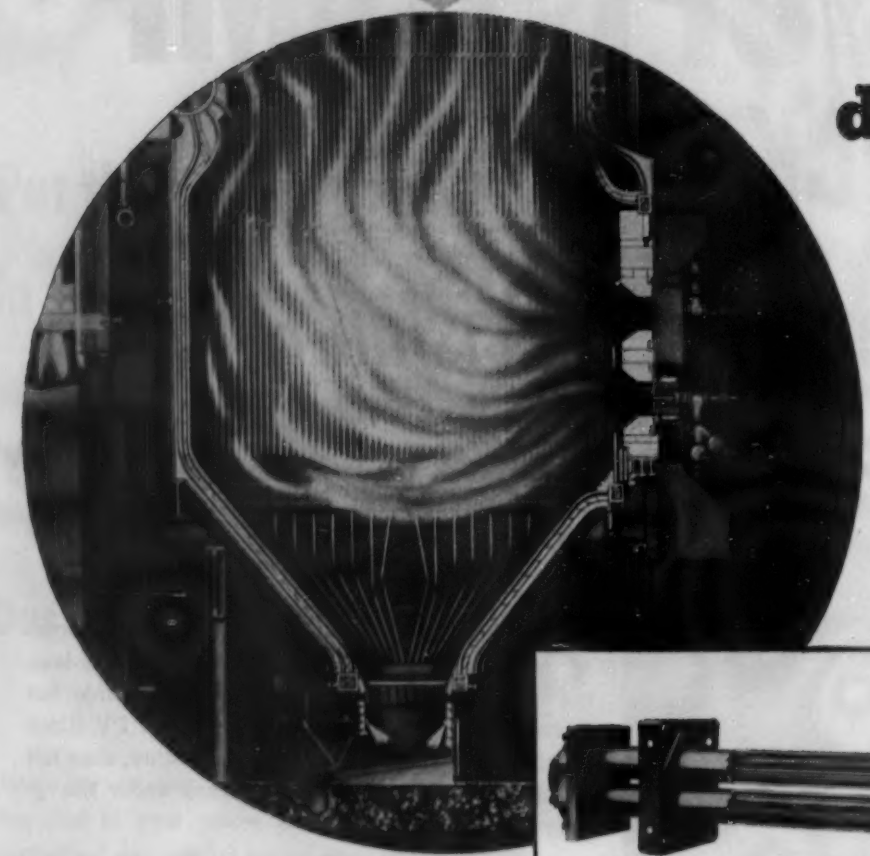
*(Member of Industrial Mineral Fiber Institute)*

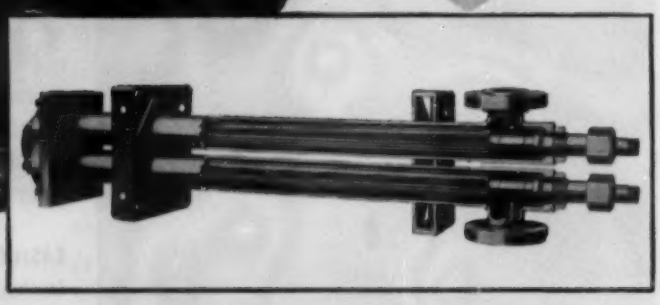


*(Conforms to Commercial Standard CS 117)*

# Where $250,000.....

# depends on $250.





Many large-capacity high-pressure oil-burning boilers cost as much as a quarter of a million dollars; while the little fuel oil heaters that serve them cost only a few hundred dollars. But these huge boilers can deliver the desired steam only if the little heaters maintain rated capacity and preheat the fuel oil sufficiently to assure free flow.

G-R Fuel Oil Heaters will give your boilers . . . and you . . . this assurance. Their reliable ratings are based on the G-R 85 years of experience in heat transfer. Their simple design and their sturdy construction, conforming to API-ASME codes, assure dependable operation. They are easy to clean and economical to maintain.

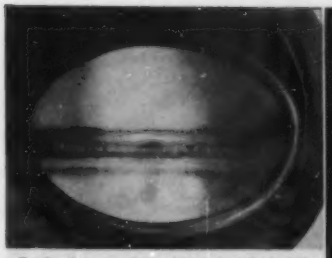
For fuel oil heaters with these important features, investigate the G-R Line.

**THE GRISCOM-RUSSELL CO. • MASSILLON, OHIO**

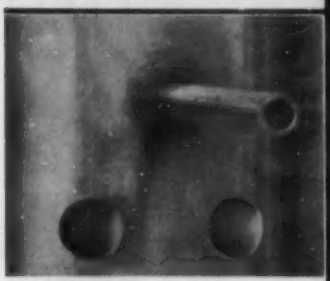
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

G-R HEAT TRANSFER APPARATUS **Fuel Oil Heater**

GR-325

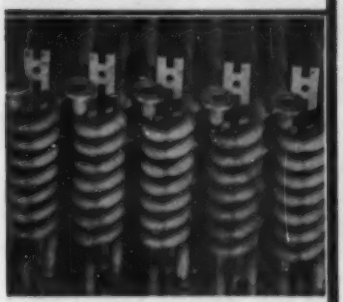


Typically smooth, uniform inside bead in stainless steel piping which results from making root pass with PP&E "free flow" inert gas shielded tungsten arc-welding process.



Stainless steel thin wall tubing is soundly welded to heavy stainless steel body by a skillful PP&E inert gas tungsten arc-welder.

Smooth external surfaces of welds on this component are the result of long experience in welding stainless steels.



Condenser coils of stainless steel, completely prefabricated at Pittsburgh Piping and Equipment Company.

Sound, clean joint having uniform root bead of correct internal contour is result of Pittsburgh Piping's tungsten arc-weld process which provides "free flow" of inert gas on internal and external surfaces of root pass.

# EXPERT FABRICATION of Stainless Piping FOR POWER OR PROCESS

At PP&E we have been fabricating stainless steel piping since the middle 1920's . . . extended experience which is unsurpassed by any other power piping fabricator. The importance of this experience, to you, is its great value in avoiding errors in omission and commission which can result in inefficiency, damage to expensive equipment, and dangerous operating conditions. Consult our nearest representative for further information.

*Promoting Progress* **IN POWER AND PROCESS PIPING . . .**

**Pittsburgh Piping AND EQUIPMENT COMPANY**

10 Forty-Third Street—Pittsburgh, Penna. PP-9

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| Boston | 10 High Street | Los Angeles | 1830 N. Alexandria Ave. |
| Chicago | Peoples Gas Building | New Orleans | P. O. Box 74 |
| Cleveland | Public Square Building | New York | Woolworth Building |

# Endurance and Operating Characteristics Tests at New Koppers Lab help develop better couplings

At the Koppers Metal Products Division, engineers and technicians are at work in a new Mechanical Development Laboratory. Their purpose—to maintain Koppers leadership by improving present products and developing new products and adaptations.

Modern coupling development is an important phase of the laboratory's operations. Present day couplings as well as models of advanced coupling designs undergo actual "load tests" to prove endurance and to study operating characteristics. From this Koppers research and development comes the promise of new, more efficient Fast's Couplings for the future—enabling Koppers to continue to give you the *right* coupling for *any* job.

The new Koppers Mechanical Development Laboratory will benefit all industry. To put these benefits to work directly for you, consult Koppers whenever you have any coupling problem.

## New lab studies all Koppers products

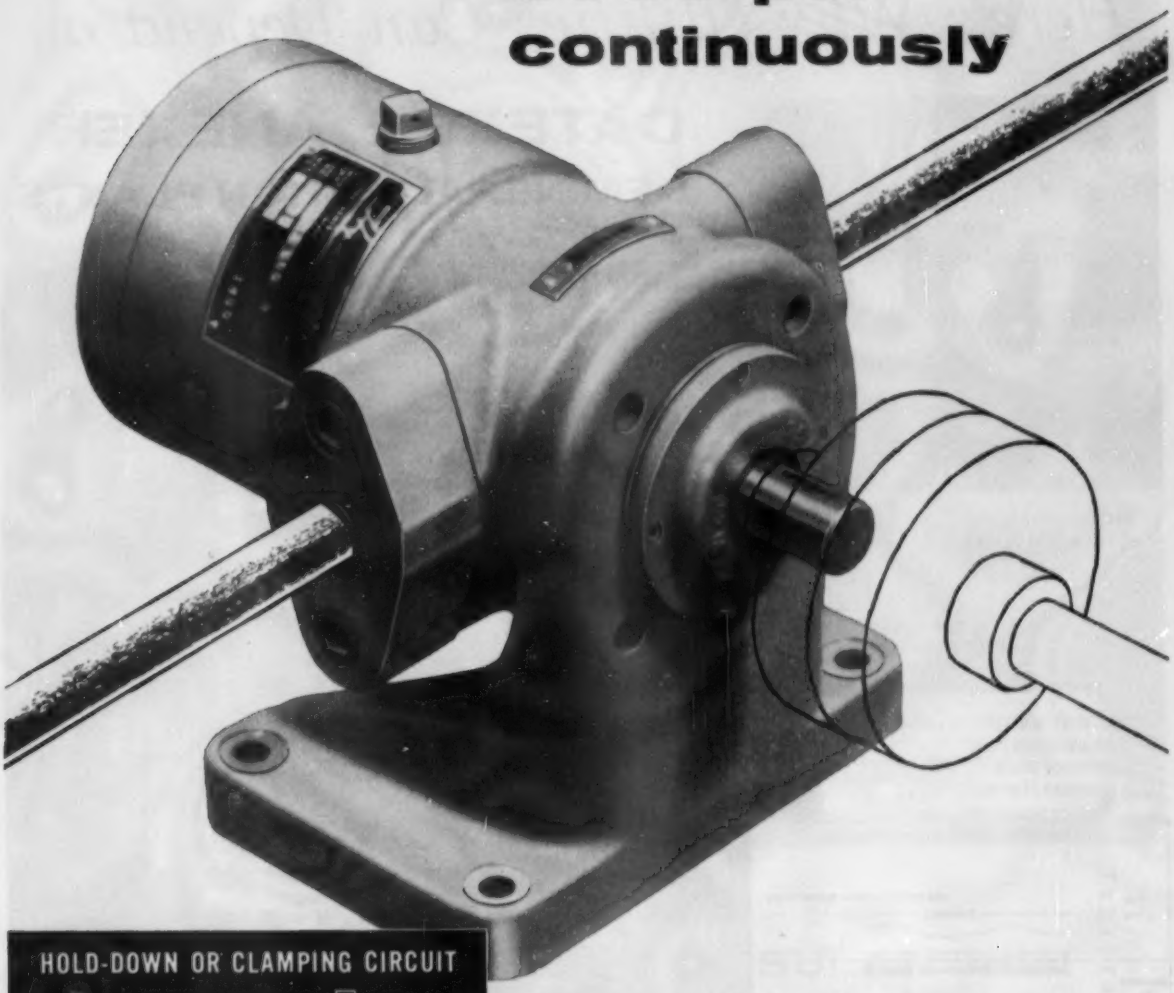
Research and testing under way in the new Koppers Development Laboratory includes: Endurance and operating tests for couplings, engine tests for piston and sealing ring endurance and characteristics, new precipitator controls and electrical equipment, pilot-plant tests of gas flow and distribution . . . and many more developments that will keep *all* products of Koppers Metal Products Division the most advanced in their field.

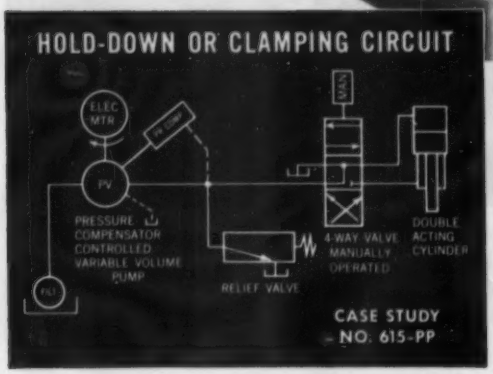
THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC., 225 SCOTT ST., BALTIMORE 3, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans, Gas Apparatus. Engineered Products Sold with Service

# 5000 psi— continuously






DENISON Hydr OILics

PUMPS • MOTORS • CONTROLS • PRESSES

**Denison Axial Piston Pumps operate continuously at 5000 psi, deliver up to 35 gallons per minute**

Few hydraulic pumps can operate at 5000 psi. And, if they can, it's for only a few seconds at 5000 psi. Not so with Denison Axial Piston Pumps. They deliver up to 35 gpm at 5000 psi . . . continuously. Yet they cost no more than many pumps with lower pressure ratings.

Three sizes deliver 10, 20 and 35 gpm. Available in constant or variable volume types . . . with handwheel, pressure-compensating, stem or cylinder volume controls. Mountings: Face, flange or foot.

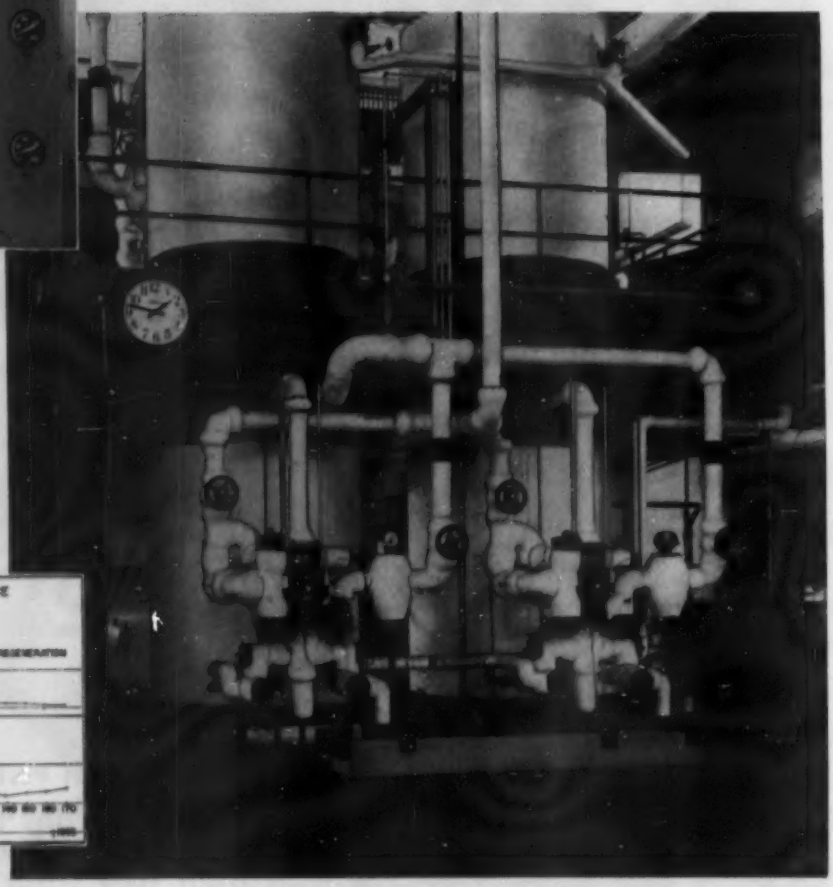
The circuit shows a Denison Axial Piston Pump in a hold-down or clamping circuit. Write us for bulletins about Denison pumps.

**THE DENISON ENGINEERING COMPANY**
1214 Dublin Road • Columbus 16, Ohio

# *Here's Why Utilities Can Depend on*

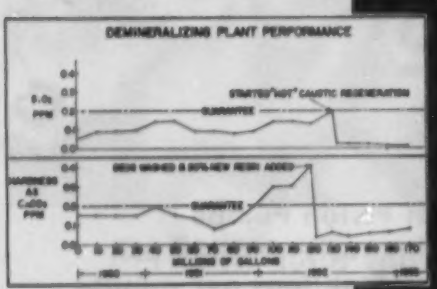
## CATEXER® ANEXER®
## DEMINERALIZATION PLANTS

Control panel designed and assembled by INFILCO



Waukegan Station Demineralization Plant

"CATEXER" "ANEXER" Demineralization Plant performance charts at Waukegan Station.




Five years ago, INFILCO pioneered the first large scale use of demineralization and silica removal by ion exchange for makeup to high pressure boilers at Commonwealth Edison Company's Waukegan Station. Accurate records show that this 240 gallon per minute fully automatic plant consistently produces an adequate supply of high-quality feedwater for both medium and high-pressure boilers. Now, five years after it was first put in operation, the plant is still doing the job for which it was designed.

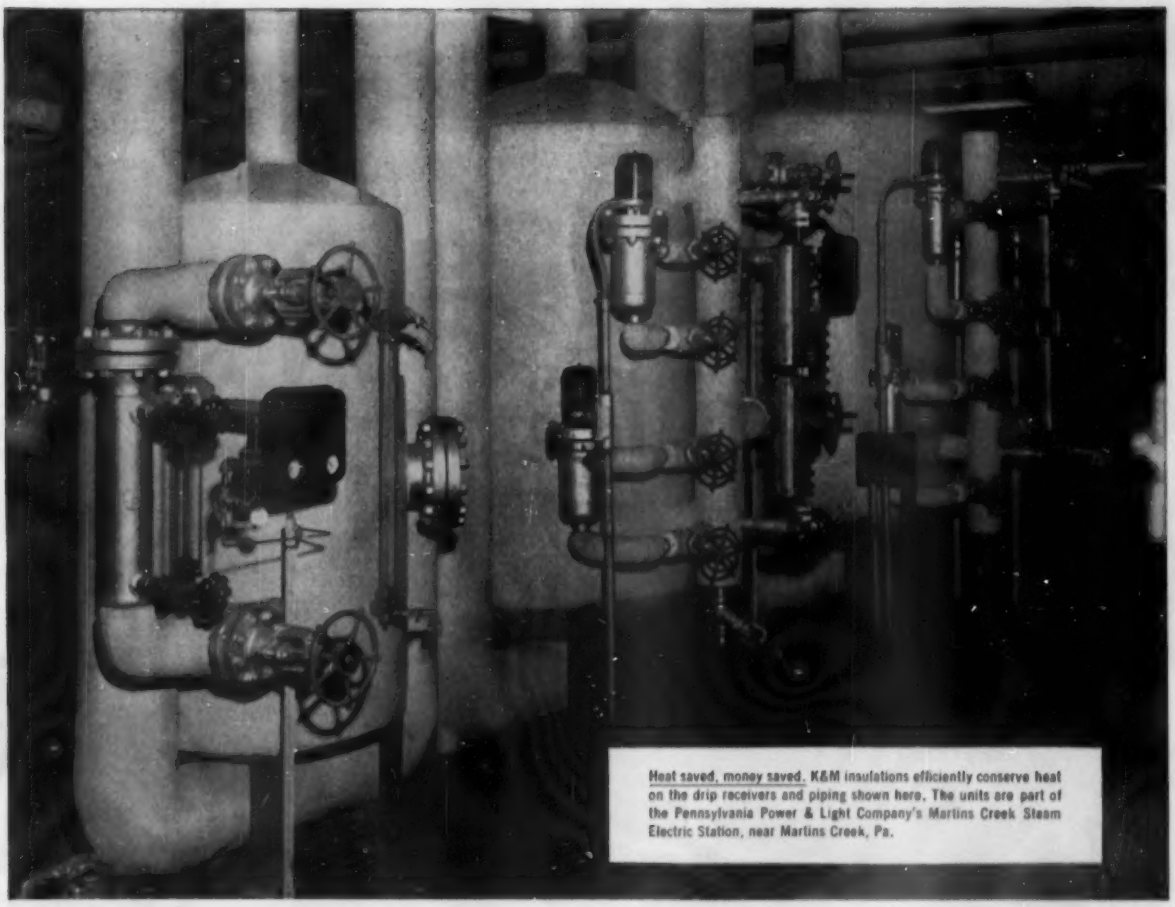
When you specify an INFILCO Demineralization Plant, you can rely on its performance because it is designed by a firm with the widest range of engineering know-how in the water and waste treatment field. For more information see your Consulting Engineer or write.

INFILCO

The one company offering equipment for all types of water and waste treatment, coagulation, precipitation, sedimentation flotation, filtration, ion exchange and biological purification.

**INFILCO INC.** 917 South Campbell Avenue, Tucson, Arizona
*Offices in principal cities in North America*

5524—©INFILCO INC.



Heat saved, money saved. K&M insulations efficiently conserve heat on the drip receivers and piping shown here. The units are part of the Pennsylvania Power & Light Company's Martins Creek Steam Electric Station, near Martins Creek, Pa.

## Keep Heat Losses Down with

# K&M HIGH PRESSURE INSULATIONS!

Efficient heat conservation means *real* dollar savings. Get those savings by using K&M high pressure insulations—known for years for their exceptional efficiency in minimizing heat losses.

K&M "Featherweight"® 85% Magnesia and K&M Hy-Temp Insulation last the life of the equipment they serve. They withstand moisture, vibration, and frequent temperature changes. Both are supplied in various sizes and thicknesses. When used together, these materials—with staggered joints—eliminate the heat loss that normally occurs in single layer installations when expansion causes joints to open.

**Efficiency to 1900° F.** K&M Hy-Temp Insulation is used on applications where temperatures rise to 1900° F. It's made of diatomaceous silica combined with heat-resistant mineral fillers and asbestos fiber. Usually, it's applied in combination with K&M "Featherweight" 85% Magnesia.

**Efficiency to 600°F.** K&M "Featherweight" 85% Magnesia is used for effective insulation of piping and equipment with temperatures up to 600° F. 85% of this material is composed of basic carbonate of magnesia, the remainder of asbestos fiber.

**Efficiency to 450°F.** K&M "Featherweight" Water-Resistant Magnesia Insulation is used on equipment with temperatures up to 450° F. It is especially effective where severe water exposure may damage insulation, or where high humidity and moisture are present.

**Act today.** Don't let continued heat losses keep operating expenses piling up. Contact your K&M distributor for information on these insulations, or write directly to us.

**KEASBEY & MATTISON**
COMPANY • AMBLER • PENNSYLVANIA

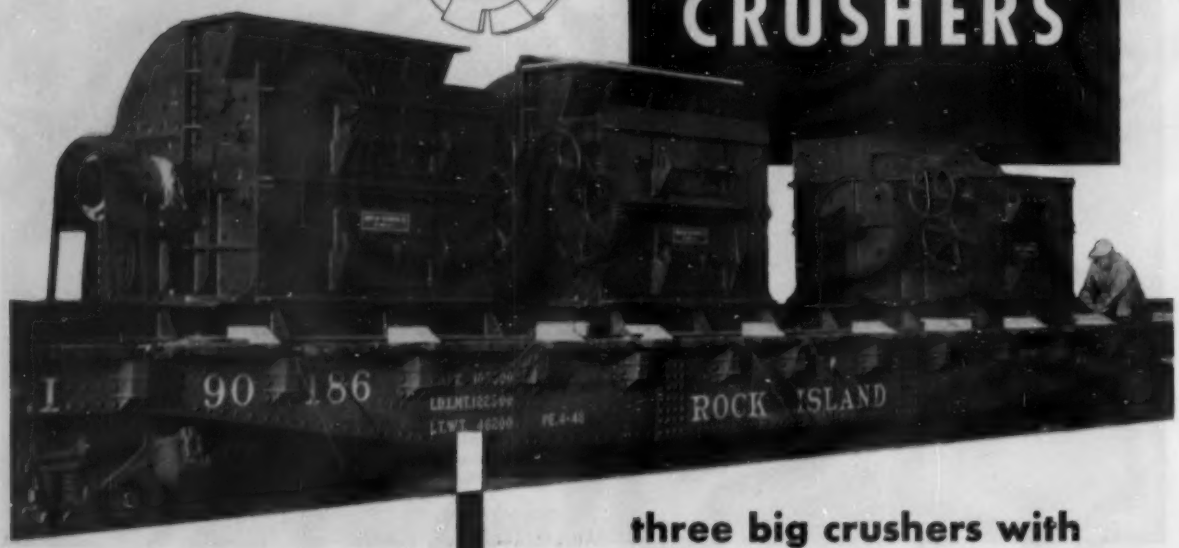
K&M best in asbestos®

IN CANADA: ATLAS ASBESTOS COMPANY, LIMITED, MONTREAL, TORONTO, WINNIPEG AND VANCOUVER

on their way
to better
coal preparation

"AC"
ROLLING RING
COAL
CRUSHERS

COAL IS SPLIT
-NOT CRUSHED



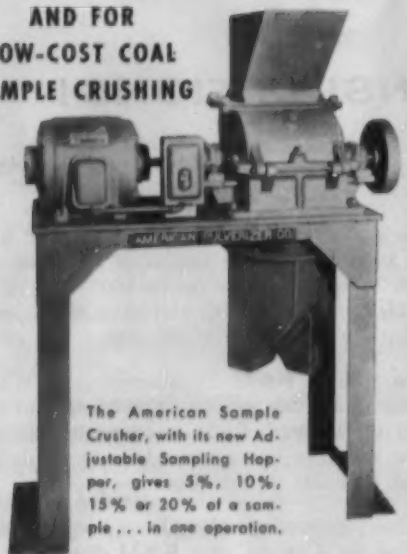

three big crushers with
the 'BIG THREE' advantages

1 **BETTER REDUCTION.** The exclusive American Rolling Ring reduction principle . . . designed to *split* coal instead of crushing it. Result: *controlled uniformity* in all coal reduction.

2 **HIGHER TONNAGE.** A "big appetite" (up to 800 t.p.h., depending on size of feed and product desired) in a *compact unit* with minimum headroom requirements for easier installation.

3 **LOWER MAINTENANCE.** Not a mere claim, but actual performance, backed by the operation records of scores of coal mines and power plants all over the country—records that prove Americans operate at a *total cost of less than 1¢ per ton of coal crushed!*

AND FOR
LOW-COST COAL
SAMPLE CRUSHING



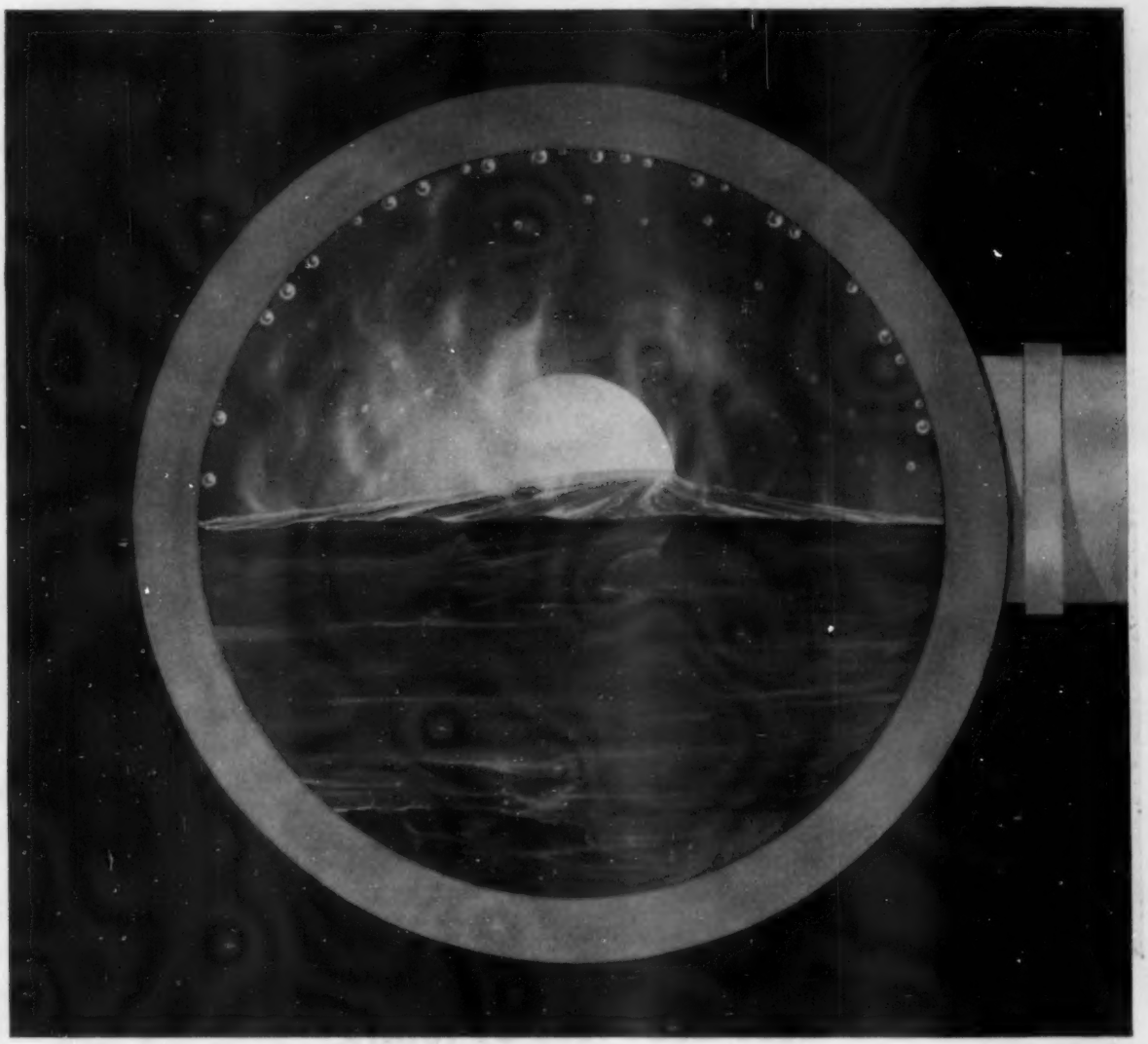
The American Sample Crusher, with its new Adjustable Sampling Hopper, gives 5%, 10%, 15% or 20% of a sample . . . in one operation.

● *WANT MORE INFORMATION*
on better coal preparation?
Write for Bulletin AC.

American
PULVERIZER COMPANY

*Originators and Manufacturers of Ring Crushers and Pulverizers*

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.



## WHAT'S A MONOMOLECULAR FILM?

It is a film one molecule thick. Filmeen* in steam or condensate lines produces a monomolecular film.

But, there's a lot more to it than thickness. The film's most important function is protection against corrosion. By forming a nonwettable coating on all metal surfaces with which treated steam or condensate come in contact, Filmeen provides a protective, corrosion-inhibiting barrier between water and metal. In heat exchange equipment, the condensed steam treated with Filmeen then forms as spherical drops of water which resist adherence to the film surface, much the same as a drop of water will form into a small ball on a waxed surface. This phenomenon results in increased rate of heat transfer—which in turn saves money in power plant operation.

When steam condenses on untreated return lines, it forms a continuous layer of water that restricts heat transfer. You don't want that... it raises the cost of heat.

Your Dearborn sales engineer will gladly explain how Filmeen can keep your heating costs in line.

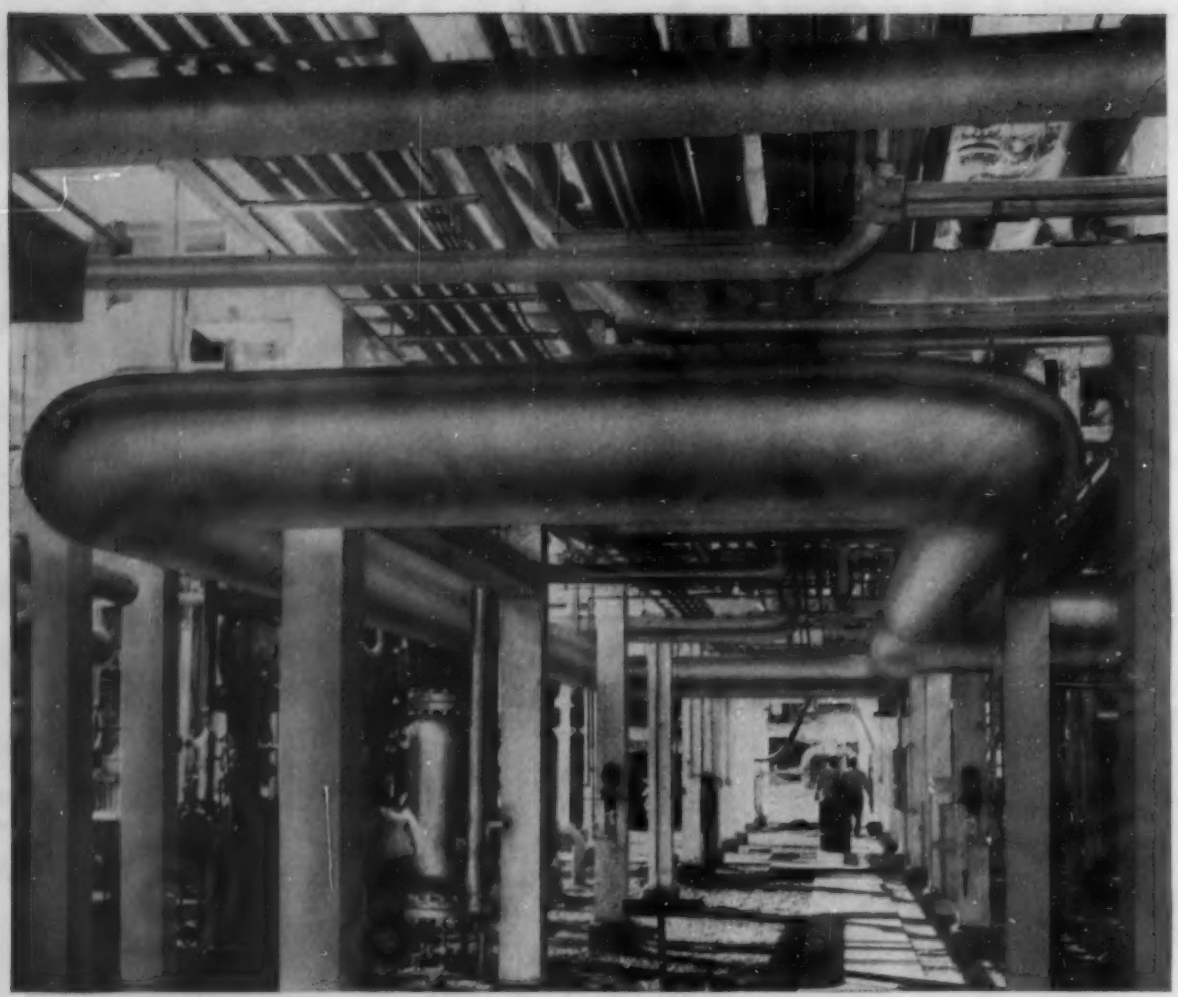
**Filmeen is the trade-mark of a corrosion-inhibiting compound produced exclusively by Dearborn Chemical Co. U.S. Pat. No. RE 23614.*

**Dearborn®**

**a leader in water conditioning and corrosion control**

Dearborn Chemical Company
Dept. PO, Merchandise Mart Plaza, Chicago 54, Ill.
Please send me complete information about Filmeen.

*Name*.....*Title*.....
*Company*.....
*Address*.....
*City*.....*Zone*.....*State*.....



# Less heat loss at joints with single-layer Unibestos® Pipe Insulation

Tests prove that Unibestos single-layer pipe insulation actually provides greater protection than other nonfibrous *double-layer* insulations which cost more to install. Unibestos is made of Amosite—the long-fibered African asbestos. These fibers interlock with one another to prevent heat loss at horizontal and longitudinal joints.

While most insulating materials show a pronounced shrinkage at high temperatures, Unibestos has no measurable shrinkage at 1200°F. It will not powder, pulp or wash off, even under heavy moisture conditions, and when dry, Unibestos resumes its original thermal and physical characteristics.

***EASY to install . . . easy to remove.***

Unibestos can be cut, mitered and handled easily. The fabrication of insulation for tees, valves, flange covers, etc., is a fast, low-cost operation. Because of its unusual strength and durability Unibestos can be removed and replaced with little or no loss of material.

## STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

***For complete information, write for descriptive Bulletin 109C***

UNARCO

**UNION ASBESTOS & RUBBER COMPANY**

**1111 West Perry Street • Bloomington, Illinois**

*FINANCIAL AID TO HIGHER EDUCATION*

# Business Help for Our Colleges A Job for All Business Firms

**IN** recent months, individual business firms have announced the adoption of a variety of plans, both imposing and ingenious, for financial aid to higher education in the United States. In doing so, they have taken a lead in dealing with a problem of transcendent importance both to the business community and to our nation as a whole.

Previous editorials in this special series have shown that:

1. Our colleges and universities, and particularly the independent, privately endowed institutions, are in grave financial difficulties.

2. These difficulties promise to become much more acute in the years immediately ahead unless extraordinary steps are taken to relieve them.

3. A financially crippled system of higher education is a major national menace.

**If, however, the business community is to play an adequate part in helping our colleges and universities financially, the plans adopted by business firms thus far constitute merely a beginning and a set of guide posts. What is required is a general movement on the part of business firms to go to the financial aid of higher education.** Such a movement would involve a myriad of individual company plans which, in the nature of the case, cannot be expected to bring great renown or publicity to their sponsors.

## Rescue Operation Is Feasible

For the business community as a whole it is feasible to make a major and possibly a decisive contribution to putting our colleges and universities back on their feet financially. One percent of business profits before taxes would do it. In 1954 business profits before taxes were about $35 billion. If one percent of these profits, or $350 million, were contributed to our independent, privately endowed colleges and universities it would enable these institutions (1) to increase the salaries they pay by $200 million a year, and (2) to provide $150 million more for modernization and maintenance of their establishments. In the opinion of competent authorities, this would put these institutions in relatively good working order financially, a process to which a matching grant of $50 million by the Ford Foundation for the improvement of faculty salaries will make a large contribution. It would add about one-fourth to their present annual outlay of about $1.4 billion.

Such a contribution from business would not meet the needs of the independent institutions for new buildings and equipment required to accommodate the great increase in college enrollment anticipated in the years immediately ahead. Neither would it relieve the financial problems of our tax-supported colleges and universities. As a group these institutions have fared better financially in recent years than the

independent institutions. But they also face grave financial problems, particularly in the provision of adequate faculty salaries. It would be far simpler, however, to solve the financial problems of the tax-supported institutions if the independent colleges and universities were back on their feet financially.

## One Dollar Does Work of Two

The federal government exempts 5 percent of business profits from the tax imposed upon them if the 5 percent is devoted to religious, charitable or educational purposes. (Most profits are taxed 52 percent.) A contribution of one percent of business profits to higher educational institutions would exhaust only one-fifth of this allowance. It would bring to about two percent the total share of business profits going to both educational and charitable purposes.

In 1953, business firms contributed about $400 million, or slightly more than one percent of profits before taxes to educational and charitable purposes of all kinds. Of this total about $75 million went to educational institutions, mostly colleges and universities.

For some companies it is feasible to contribute more than the average contributed by business generally. Indeed, some companies not only utilize their full 5 percent of tax-deductible funds for charitable and educational purposes but go beyond it. For other companies in financial difficulties no contribution at all is possible.

If, however, those business firms for which it is financially feasible contributed one percent of their profits before taxes to our colleges and universities, the problem of adequate support for the crucially important business of higher education would be far along the way to successful solution. **In 1954 a contribution of one percent of their profits before taxes, or about $350 million, would have reduced business profits after taxes by only about half that amount. This would have meant a reduction of about $175 million, out of a total of about $17.8 billion of profits after taxes.**

Attractive plans to channel financial aid from business to higher education have been abundantly demonstrated recently. These plans, for the most part the creation of large corporations, have included not only a broad array of scholarship grants, but such ingenious arrangements as that by which a company matches with its funds the gifts its employees make to the colleges of which they are alumni.

A full array of these plans, some of which were discussed in an earlier editorial in this series, has been prepared by The Council for Financial Aid to Education (6 East 45th Street, New York City 17) and is available for the asking. Also, colleges and universities have established in most states and regions cooperative associations to help business help them. The Commision on Colleges and Industry (912 Kahn Building, Indianapolis 4, Indiana) distributes a directory of these associations. And, of course, the colleges themselves are always eager to discuss their financial problems with business people and suggest constructive solutions.

## Only Small Start Made

The plans for business aid to education which have recently attracted national attention constitute the conspicuous sort of leadership which it is the privilege and opportunity of our great corporations to provide. But the job is too large to be handled by a small number of business firms, no matter how bold or ingenious their programs.

**To put our colleges and universities back on a firm footing financially the help of the great rank and file of business corporations is required. All of them, large and small, have a crucial stake in seeing that this job is done. The future of America will be decisively shaped by what happens in and to our college classrooms.**

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.*

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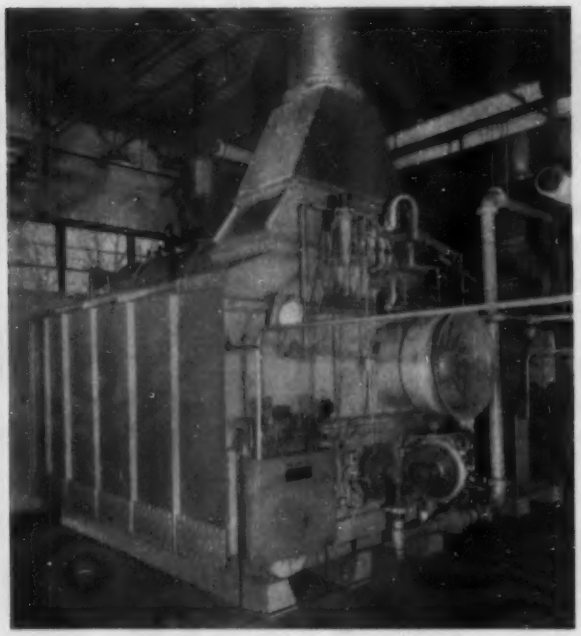
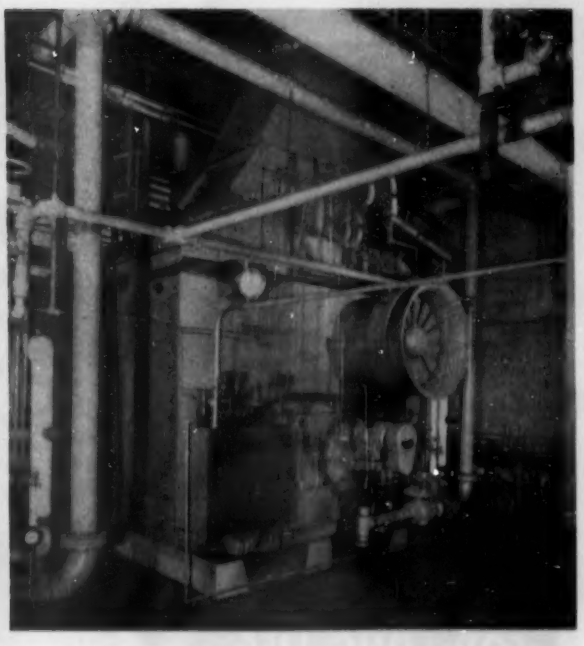
Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.





# Union packaged boiler twins perform two key jobs for modern mid-west feed plant

Job Report (UIW)—Side by side in the Springfield, Missouri plant of Consolidated Products Company, two Union Type "MH" Packaged Steam Generators play a dual role in the manufacture of livestock and poultry feeds. They produce steam for processing milk by-products and for building heat.

Reported to "have proven very satisfactory and dependable sources of steam" by Consolidated, these packaged units were completely shop-assembled by Union Iron Works in Erie, Pa. before shipment to their midwest job site. Each of the pair has a steam capacity of 22,500 lbs. per hour and is equipped for burning heavy oil or gas.

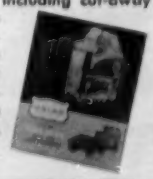
Stressing the selection of MH Steam Generators "on the basis of good design," Consolidated Products Co. adds, "Union Iron Works had previously given us excellent service on several coal-fired, water tube boilers."

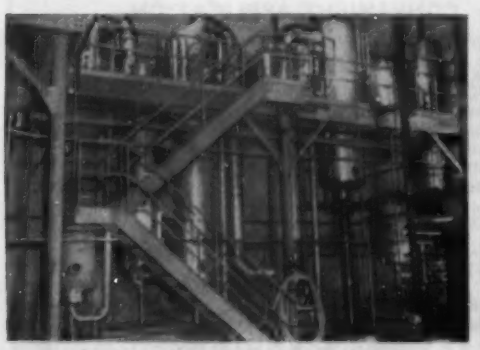
From Oregon to Alabama, Union Type MH Steam Generators have been installed in breweries, chemical processing plants, pulp and paper mills, refineries, schools and institutions, to name but a few.

Patterned after larger but similar field erected Type H Boilers, originated by Union over 16 years ago, shop-assembled MH Units can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering. Superheaters can be installed to meet total temperature requirements, while both air heaters and economizers are readily supplied when needed.

Standard units are designed in 13 sizes from 10,000 to 40,000 lbs. of steam per hour at 250 psi, with higher pressures available for special applications.

**The complete story on Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.**





**VACUUM CONDENSING EQUIPMENT** inside Springfield plant utilizes steam produced by MH Units to process milk by-products.

**SPRINGFIELD BLENDING PLANT** — One of 38 plants operated by Consolidated Products Co. to produce livestock and poultry feed.

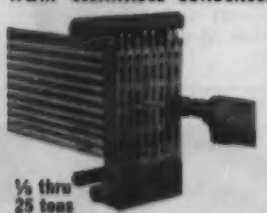
# 20-Year Guarantee!

**ON THE WETTED DECK SURFACE**

Only Halstead & Mitchell can offer a 20-Year Guarantee on the wetted deck surface against rotting and fungus attack *because* only Halstead & Mitchell pressure-creosoted cooling tower wood. No other material, subject to deterioration or rusting, can offer this long life.

Stainless steel fans and shafts, sheet steel cabinets hydraulically painted with vinsynite, vinyl zinc and chlorinated rubber . . . provide protection for the longest life. There's no extra cost for these extras . . . just extra long time benefits on the job.

**H&M CLEANABLE CONDENSERS ADD YEARS OF LIFE, TOO!**




Your cooling tower works with a condenser, and Halstead & Mitchell is the world's largest manufacturer of double-tube, counterflow CLEANABLE condensers. You maintain heat transfer efficiency at new unit level with easy cleanability. Why settle for less?

*Write for Cooling Tower Catalog WT & CT 583, Condenser Bulletin C-3*

HM Halstead & Mitchell

BESSEMER BUILDING, PITTSBURGH 22, PA.

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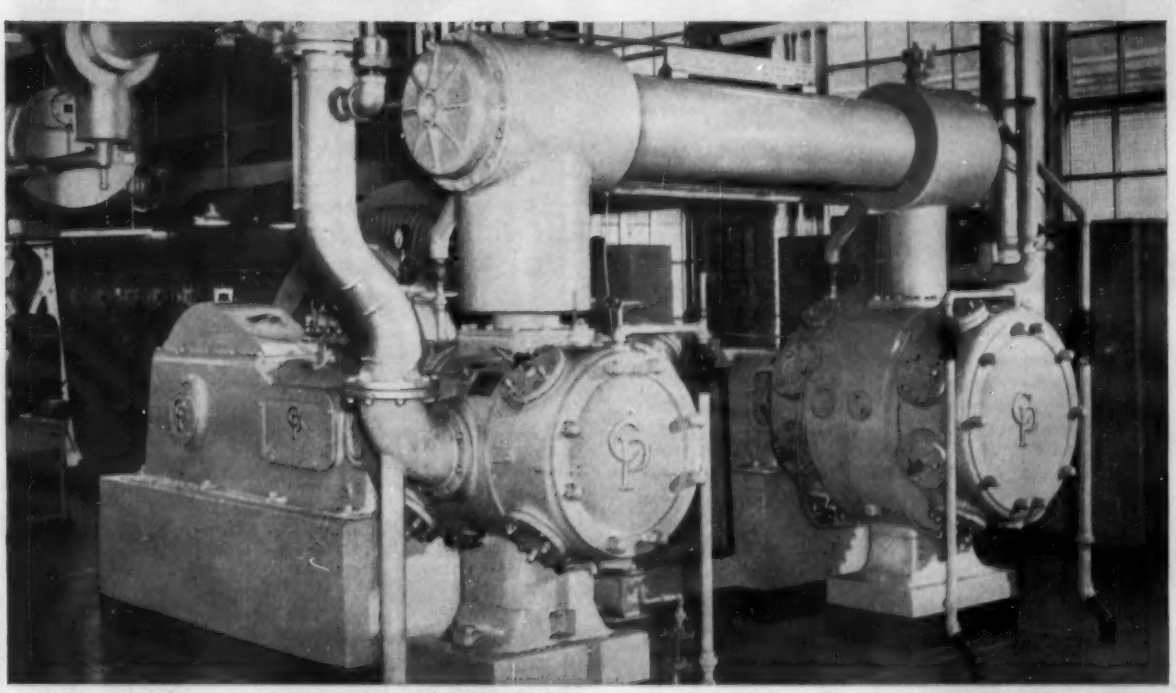
## key to compressor dependability



The dependability of CP's heavy-duty Class O-CE horizontal duplex compressors is reflected in repeat orders. Typical of these is one from a prominent electrical manufacturer: The first CP Compressor in this plant—300 HP size—was installed in 1935 . . . the second—rated 409 HP—was added in 1951. Both operate continuously, with remarkably low upkeep . . . and they should be "going strong" in 1975.

The long life, low upkeep and high efficiency of O-CE Compressors are due to their moderate ratings, Simplate Valves, completely effective and easy-to-clean intercoolers, and their roller main and crankpin bearings. Built in sizes up to 2,000 HP, they're available in single and multi-stage designs, steam and electric drives, for pressures up to 15,000 pounds. For details write *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

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*Longer life*

**PALMETTO PYRAMID®**

*helps safeguard*

**TAYLOR FIBRE**

*reputation*

One of the Palmetto Pyramid equipped multiple-ram hydraulic presses in Norristown, Pa., plant of Taylor Fibre Co.

Production efficiency is affected by replacement of short-lived Vee packings used as a ram seal on Taylor Fibre Company's multiple ram, heated platen, hydraulic presses. Service conditions are above normal—2800 psi pure water at 96 F—but continual press operation is vital to production if Taylor Fibre's enviable reputation for prompt service is to be maintained.

Palmetto Pyramid packing, used because of its special heavier construction and rugged design, keeps their presses in operation for an entire year without replacement. Taylor Fibre saves money by reducing downtime, maintains delivery schedules, and pays no more for a packing which gives much more service.

**HELP FOR THE ASKING!**

Perhaps Pyramid or another packing in the Palmetto line will improve the performance of your operating equipment. To achieve better packing performance—longer service life, less downtime—get the assistance of a factory trained Greene, Tweed representative . . . yours for the asking. For further details on Pyramid and other Palmetto Packings, write for Greene, Tweed catalog PC-102.

*NOTE: For the name and location of the Palmetto distributor nearest you, see Greene, Tweed's two-color insert at the head of the packing section in Thomas' Register.*

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*packing more performance into every application*

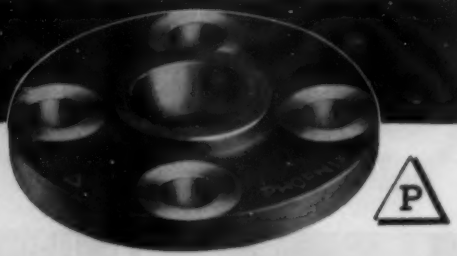
**GREENE, TWEED & CO.** NORTH WALES, PENNSYLVANIA



PHOENIX *Drop-Forged* FLANGES

MEAN . . .

**MAXIMUM STRENGTH**



**Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.**

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**PHOENIX MANUFACTURING CO.**

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- They deliver more horsepower per pound.
- They last longer—and at higher temperatures.
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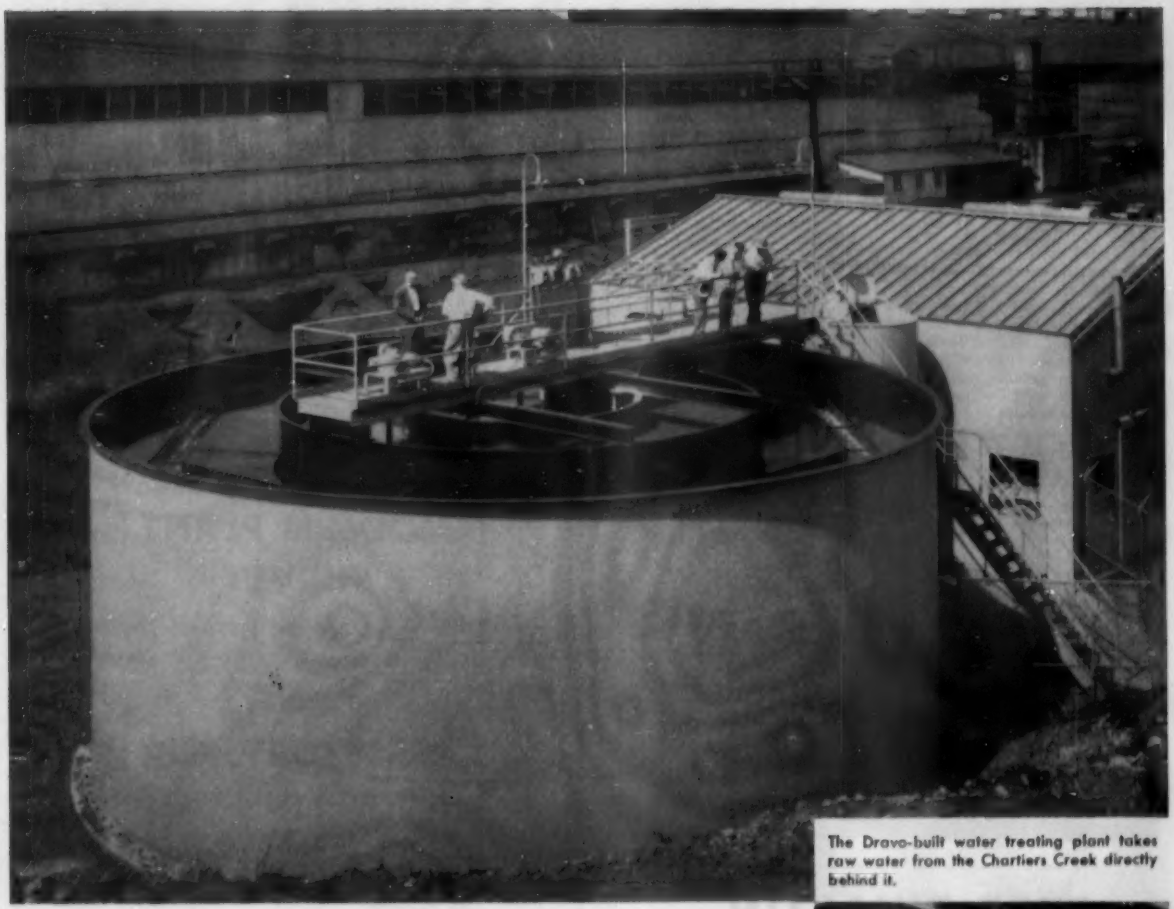
- More of their area is enclosed.

—and that's only a start. Much more is new and important about motors.

Watch for "Motors in Industry," a special report 32 pages long and beautifully illustrated, coming in the June issue of POWER.



The Dravo-built water treating plant takes raw water from the Chartiers Creek directly behind it.

# Mill water problem solved for Universal Cyclops Steel

Complete water clarification takes place in the Walker Clariflow Unit. Note difference between raw turbid water in inner zone and clean water in the outer settling zone.

As the third largest U. S. producer of specialty steels, Universal Cyclops Steel Company at Bridgeville, Pa., uses a million gallons of water per day in its plant operations. Since raw water is taken from a small stream heavy in iron compounds, the water system has been hampered by frequent pipe maintenance problems. To solve this problem, and meet increasing needs for water, Universal Cyclops called on Dravo to install a new water treatment plant.

This new plant supplies double the capacity of the old system, and effectively controls the iron deposit and other concentrations that were playing havoc with the water piping. The installation includes a 1500 gpm Walker Process Clariflow Unit, pumps, chemical feeders, clear water reservoir, required building and foundations.

This is typical of the many varied construction assignments performed by Dravo. Building complete power plants, water pumping stations, oil or gas pipeline facilities, water or waste treatment plants . . . on a single contract or "turn-key" basis is one of the several ways Dravo can serve your needs. Find out how Dravo can serve you best—write today for your copy of Bulletin #1200.

Centrifugal pumps, in the rear, pump raw water into system. Pumps in foreground deliver clear water to 700,000 gallon storage tank for use in the mill.

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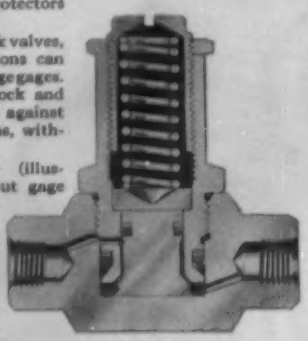
Ask for Gage Protector Bulletin No. 554, or new catalog No. 654 showing entire line.



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Prevents galvanic pitting even where dissimilar metals are joined! Protects all threaded surfaces of bolts, plugs and studs, insuring their repeated re-use. WRITE TODAY FOR FREE BULLETIN!

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Here's why you will *keep* and *use* your copy of POWER's MODERN PLANT YEARBOOK coming September 15th

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In which Power gives recognition for the year's outstanding jobs in power service modernization, along with the facts you need on each project.

## MODERN PLANT SURVEY

Tabulated data on new and proposed plants, both steam and hydro. What is the trend in power plant design?

## DIRECTORY FOR MODERNIZATION

The only directory published of power field equipment and who makes it. Lists over 700 products and over 1500 manufacturers.

## CROSS FILE OF OBSOLESCENCE

Former manufacturers of power field equipment matched with successor company's name. One of this issue's most useful features.

## THE SHOWCASE

An up-to-date compilation of important new products, new bulletins and cards for ordering additional information.

***Watch for***

## THE MODERN PLANT YEARBOOK

**Coming September 15th**

# NEWS IN TEMPERATURE MEASUREMENT AND CONTROL!

## HAGAN MODEL "P" AMPLIFIER SETS NEW RECORDS FOR

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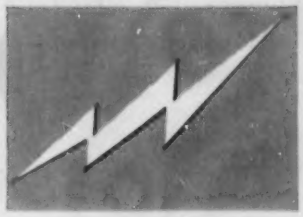

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NO SLIDE WIRES — NO REVERSING MOTORS

# CONTROL

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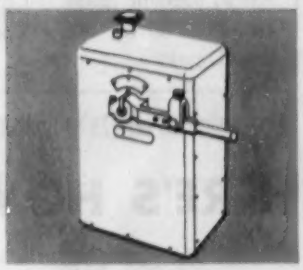
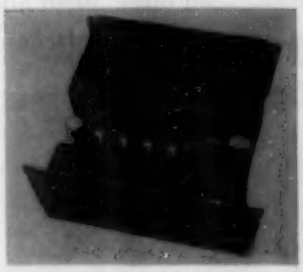


The Hagan PowrAmp Model "P" DC Amplifier boosts over-all steam plant efficiency by making possible more precise temperature control. Use the Model "P" ***to control*** . . . **reheat steam temperature . . . superheat steam temperature—*to measure* . . . flue gas temperature . . . tube metal temperature . . . electrical power . . . pressure.**

Because of its feedback stabilized circuit and its drift-free linearity, the Model "P" provides the steam plant operator with a new and highly efficient method of temperature measurement and control.



**HAGAN POWRAMP MODEL "P" DC AMPLIFIER**

Send for Hagan Bulletin MSP 111.1 for the full story on this versatile and money-saving instrument.

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You can stop such losses in your plant by knowing how to select and apply sealing devices.

Now, for the first time, the information you need to do this cost-cutting job is available in a single package.

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We have a new lot of coal and it clinkers badly. He's digging the clinkers out and covering up holes in the fuelbed.

## Don't holes in the fuelbed make clinkers?

They sure do! And the air required for combustion goes through these holes and we can't keep the steam pressure up.

## Why did we buy such coal?

Well, it was a few cents cheaper and we didn't consider the analyses so nobody realized it had such a low clinkering temperature.

## So we save pennies on the coal and blow dollars up the chimney!

Yes sir! That's about the size of it. But just as soon as this lot is used up, we're going back to the old coal. That was specified for us by the Chesapeake and Ohio Fuel Service Engineers to give us the lowest *steam cost* with our type of stoker and boiler. We should have stuck with the coal they recommended – it never gave us a bit of trouble.

P.S. There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

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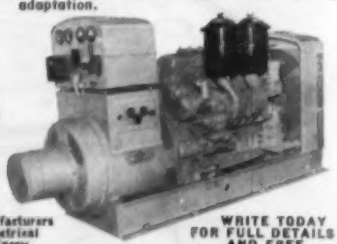

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POWER, 330 West 42nd St., New York 36, N. Y.

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**Power Plant Superintendent, age 33, married,** technical education, 10 years experience in the operation and maintenance of steam-electric power plants. Understands personnel problems. PW-6009, Power.

**Graduate Engineer: 24 years of chemical and** mechanical engineering background in chemical industry, power plants and water treatment. Includes all phases from designer to top level administration of major projects and also plant start-up and betterment. Desire opportunity to utilize talents at top level with medium sized chemical entity or consulting engineers or contractor. Presently employed. Available on reasonable notice. PW-6305, Power.

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**CHICAGO PNEUMATIC MODEL 68CP, 225 HP, 720 R.P.M. Diesel Complete, in excellent condition.**

**Direct connected EM 200 KW, 440 volt, 3 phase, 60 cycle Generator, like new. EM switchboard panel complete, with necessary switches, instruments, including synchroscope, like new.**

**Price $5250 FOB Our Plant**

*Detailed Information Sent Upon Request.*

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*For full information write:*

**POWER**
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**The National Coal Association is seeking an executive, a qualified engineer, to direct administrative and promotional activities in field sales enginering service in furthering the use of coal to industry. Must have experience related to the usage of coal, preferably in industry, an understanding and appreciation of the economics of coal, and possess a strong personal makeup. Ability to deal with people, develop selling programs, and plan and direct organizational efforts. Engineering degree preferred. Age 30-50. Growth opportunity. Compensation appropriate for a qualified man. Please send reply in detail in confidence to Market Promotion Committee.**

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**Coal cutters — hoists — carpullers — screens —shakers—gear motors from 100 HP down—bucket conveyors—one 36" belt conveyor 375 ft centers — 36" x 36" Magnetic pulley — permanent overhead magnet for 36" belt—Box car loader 14 ft boom—one coal conveyor 2 miles long overhead aerial type preferred. Please rush quotation—delivery very URGENT.**

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2—300 KW G.E. 400# 2# Back. with 400 sq. ft. surface cond. air ejectors circulating pumps, etc. New 1944, with switch panels, voltage regulators, etc. Excellent. 550V 3 ph 60 cy. .80 P.F. will reconnect for 480V.

2—B&W F.F. 15-24 Boilers 450# 550° T.T. 25,000# per hr. complete with Detroit Spreader Stokers and B&W conversion oil burners, forced draft fans induced fan cinder trap and cinder return systems, with Hays Cochran comb. control panel. Stokers will be sold separately if desired.

1—125 H.P. 1740 R.P.M. West. Motor-Style 1077767 insulated for 2300—will reconnect for 2300. New condition.

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**AMESBURY, MASS.**

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400 KVA. Elliott-Ingersol Rand, 600 RPM
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250 KVA. GE-Chicago Pneu. 720 RPM
250 KVA (2) Wghse.-Buckeye 400 RPM
187 KVA Al. Chal.-Chicago, Pneumatic, 720 RPM.

### BOILERS

1000 HP. (2) B&W. 160#
250 HP. (2) B&W. 160#

### TURBO GENERATORS

125 KVA. GE. 3/60/240-480 volts, non-cond; 0 to 30# back pres.
625 KVA. GE. 3/60/480/240 v. non-cond; 0 to 15# back pres.

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### Detroit Roto Stoker

Grate 9'-3" x 11'-4" long with 3 feeders—readily altered to 2 feeders and grate shortened. No. F. D. pan included. Cinder return blower included.

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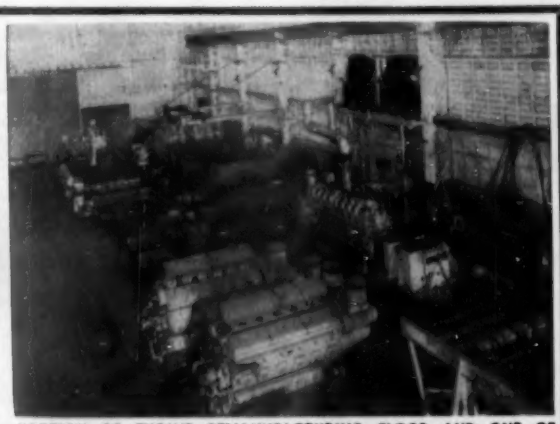

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### A PARTIAL LIST OF OUR INVENTORY

| KW | MAKE | MODEL | HP | RPM |
|---|---|---|---|---|
| 1180 | Worthington | SEH-8 | 1685 | 360 |
| 1136 | Fairbanks Morse | 38D | 1600 | 720 |
| 1100 | General Motors | 16-278A | 1600 | 720 |
| 1000 | General Motors | 16-567B | 1440 | 720 |
| 750 | General Motors | 12-567 | 1080 | 720 |
| 700 | Worthington | EE-8 | 1000 | 327 |
| 675 | Fairbanks Morse | 38D | 960 | 720 |
| *500 | Alco | 6-12½x13T | 750 | 600 |
| 500 | General Motors | 8-567 | 720 | 720 |
| *350 | Baldwin | VO-6 | 510 | 450 |
| 320 | Superior | 60-S-6 | 460 | 450 |
| *320 | Enterprise | DSG-6 | 460 | 450 |
| 300 | Fairbanks Morse | 32E14 | 450 | 300 |
| 300 | General Motors | 8-268A | 450 | 1200 |
| 200 | General Motors | 8-268A | 350 | 900 |
| *160 | Buckeye | 80 | 240 | 600 |
| 148 | Fairbanks Morse | 32E14 | 225 | 300 |
| 100 | General Motors | 3-268A | 150 | 1200 |
| 60 | General Motors | 6-71 | 90 | 1200 |

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*—indicates NEW unit

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## MOTORS!

| Amt. | Hp. | Speed | Make | Type | Frame |
|---|---|---|---|---|---|
| 1 | 200 | 900 | A-C | AR830D | |
| 1 | 150* | 1800 | A-C | 26F-220-43-10 | |
| 2 | 150* | 1800 | A-C | AWW new | 23B56 |
| 1 | 150* | 900 | G.E. | I-K (2200V) | |
| 1 | 125 | 1200 | Weg. | 26WDBP | |
| 1 | 100 | 1800 | Whse. | CS | 683C |
| 1 | 100 | 1200 | Whse. | CS | 752C |
| 1 | 100* | 900 | A-C | 2K20064.1 (2200V) | |
| 2 | 75 | 1800 | C-W | SC (BB) | 445S |
| 1 | 75* | 1200 | A-C | (2200V) BB | 423D8 |
| 1 | 75 | 900 | Whse. | CS | 753C |
| 2 | 60 | 3600 | L.A. | OGX BB | 405S |
| 1 | 60 | 1800 | G.E. | KF BB Splash | 5048 |
| 4 | 60 | 1200 | Howell | BB | 504 |
| 1 | 50 | 1720/575 | L.A. | Adjusto-Spede | 445 |
| 1 | 50 | 900 | G.E. | | 504 |

*2300 Volts

## SLIPRING!

| | | | | | |
|---|---|---|---|---|---|
| 1 | 100 | 900 | G.E. | MT356 | |
| 1 | 100 | 720 | Whse. | CW | |
| 1 | 100 | 450 | G.E. | I-M (2200V) | 16 |
| 1 | 75 | 720 | A-C | (2200V) | |
| 2 | 75 | 900 | G.E. | I-M | |
| 1 | 75 | 1800 | G.E. | IM | |
| 1 | 75 | 1800 | F-M | QV | 505S |

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### SLIP RING MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Speed |
|---|---|---|---|
| 600 | 2200 | Whse. | 450 |
| 560 | 2300/4000 | G. E. | 900 |
| 450 | 440 | Whse. | 514 |
| 450 | 440 | Whse. | 720 |
| 300 | 2300/440 | G. E. | 720 |
| 300 | 440 | G. E. (hoist) | 600 |
| 300 | 2300 | G. E. | 900 |
| 300 | 440 | Whse. | 3600 |
| 250 | 440/220 | Whse. | 600 |
| 250 | 550/440 | G. E. | 1200 |
| 200 | 440/220 | Whse. | 514 |
| 150(2) | 440/220 | G. E. | 720 |
| 150 | 2300/440 | G. E. | 600 |
| 135 | 440/220 | G. E. (hoist) | 600 |
| 125 | 440/220 | G. E. | 900 |
| 125 | 550/440 | G. E. | 1200 |
| 125 | 2300 | G. E. | 600 |

### SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Type | R.P.M. |
|---|---|---|---|---|
| 400 | 2300/440 | G. E. | ATI | 720 |
| 375 | 440/220 | Whse. | G | 900 |
| 350 | 440/220 | El. Machy. | Syn. | 1200 |
| 300 | 2300/400 | G. E. | TS | 720 |
| 300 | 2300/440 | G. E. | TS | 1200 |
| 250 | 2300/440 | G. E. | TS | 720 |
| 250 | 440/220 | Whse. | HR | 277 |
| 250 | 440/220 | G. E. | ATI | 600 |
| 125 | 440/220 | Whse. | HR | 400 |

### SQUIRREL CAGE MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 600 | 2200 | G. E. | PT | 3600 |
| 500 | 2300/4600 | Elliot | SC | 1800 |
| 500 | 2300 | G. E. | | 450 |
| 400 | 2300/460 | Whse. | CS | 720 |
| 300 | 2300 | L. Allis | FS | 1800 |
| 225(2) | 2300/440 | G. E. | KT | 1200 |
| 200 | 440 | G. E. | JK | 720 |
| 200 | 440/220 | G. E. | KT | 1800 |
| 200 | 2300/440 | G. E. | JK | 600 |
| 200 | 2300 | G. E. | KT | 1800 |
| 150 | 440/220 | Whse. | CS | 900 |
| 150 | 2300 | Al. Chal. | AR | 1800 |
| 150 | 220 | Whse. | CS | 1200 |
| 150 | 440/220 | G. E. | JK | 600 |
| 150 | 440/220 | G. E. | KT | 720 |
| 150 | 2300/440 | | KT | 600 |

### A. C. GENERATORS

1—320 kva, 600 rpm 2300/440/220 V., G.E.
1—500 kva, 900 rpm, 440/220 V., G.E.
1—225 kva, 600 rpm, 220/440 V., G.E.
1—300 kva, 720 rpm, 2300/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2300/440 V., Whse.

### CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E.
1—FKR-143, 1200 amp., 4800 V., G.E., Sol. op (new)

### D. C. MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 225 | 230 | Whse. | SK | 2870 |
| 150 | 230 | Whse. | SK | 1750 |
| 100 | 230 | Whse. | SK | 600/1200 |
| 90 | 230 | G. E. | CD | 1750 |

### MOTOR GENERATOR SETS

| KW | Make | Input V., AC | Motor Type | Output V., DC |
|---|---|---|---|---|
| 250 | Whse. | 2200 | Syn. | 250 |
| 175 | G. E. | 220/440 | Syn. | 250 |
| 125 | G. E. | 440/220 | Syn. | 250/125 |
| 100 | Al. Ch. | 220/440 | sq. ca. | 250/130 |
| 100 | Whse. | 440/220 | sq. ca. | 125 |
| 75 | G. E. | 2200/440 | Syn. | 125 |
| 60 | G. E. | 2200/440 | sq. ca. | 250 |

### TRANSFORMERS 60 Cy.

1—600 kva, Standard, 13,800-2300 V., 3 ph.
2—500 kva, Whse., 66000—2300 V.
2—333 kva, G. E., 13000—2300 V.
1—300 kva, G. E., 2300—575 V.
2—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—450/240 V.
3—150 kva, Al. Chal., 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.

*only partial listing*

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HARRY J. RICE, Pres.
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# O'Brien Offers—

### MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 2/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 2/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cy. 3/60/220
1—60 KW G.E. 250 V. 1200 RPM 90 HP 220/3/60/SYN.

### DIESEL GENERATOR SETS

3—625 KVA Inger. Rand, 3/60/480/720 rpm
3—438 KVA GM-Winton 3/60/2300/360 rpm
1—375 KVA GM 8-268 Diesel 3/60/2400
3—200 KW GM Diesels Twin 671—3/60/220/1200 RPM
1—300 KW GM 8-268 Diesel 125/250 V. D.C.
3—100 KVA Cooper Bessemer 3/60/440
1—37.5 Kato 3/60/220 Continental Gas
1—25 KVA LeRoi Gas 1/60/120/240
1—10 KW Wincharger 1/60/110-220 Gasoline

### BOILERS

1—60,000# Erie Stoker New 160 psi
1—20,000# C.E. 450# Oil
1—350 HP Cleaver Package 150 Lb.—1942
1—300 HP Keeler CP—160 Lb. Oil
1—250 HP Amos Package Type (1945) 150 psi
4—6000# C.E. 375#—1952 Comb #6 oil—gas
1—120 H.P. Int CR 352—125# W.P. #5 oil —1947
2—80 H.P. Cleaver Brooks 125# W.P. #2 oil
1—15 H.P Ontario 100# W.P.—1949
1—10 H.P. McKee 100# W.P.

### ELECTRIC MOTORS

| QU. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 500 | West. | CS | 6600/2300 | 514 |
| 1 | 450 | A.C. | ANY | 2300 | 600 |
| 1 | 400 | West. | CW | 440 | 514 |
| 1 | 400 | G.E. | Syn. | 2300 | 450 |
| 1 | 350 | G.E. | MT18 | 2300 | 400 |
| 2 | 200 | West. | CW | 2300 | 1800 |
| 1 | 200 | G.E. | I.M. | 440 | 514 |

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3—300 H.P. General Motors Twin 6-71 Radiator Cooled Heavy duty Diesel Power Units New 1952—used 200 hrs.

### TURBO GENERATORS

1—11250 KVA G.E. 3/60/13200/3600 rpm—Condensing—Boilers—Complete Plant
2—4000 KVA Allis Chalmers 3/60/2300/3600 rpm—Condensing
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

### AIR COMPRESSORS

1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—978 CFM Sullivan 13x13x8, 45 psi.
1—900 CFM C.E. 17x10x12—MTR DR. 3/60/220
1—971 CFM Schramm 7¼x6x4. 100 psi
1—368 CFM I.R. 12x10, 100 P.S.I.
1—172 CFM Chicago NSB 100 psi

### OISC TRANSFORMERS

| Qu. | KVA | Make | Pri. V. | Sec. V. | Phase |
|---|---|---|---|---|---|
| 3 | 2000 | G.E. | 13200 | 230/460 | 1 |
| 3 | 1000 | GE | 13200 | 2300 | 1 |
| 1 | 1100 | West. | 4160 | 440 | 3 |
| 1 | 750 | O'Brien New | 13200 | 480 | 3 |
| 3 | 667 | Al. Ch. | 33000 | 2300 | 1 |
| 3 | 500 | Wagner | 33000 | 2400/4160Y | 1 |
| 1 | 500 | Gregory | 4160 | 440 | 3 |
| 3 | 400 | GE | 2400 | 480 | 1 |
| 3 | 333 | Pitts. | 33000 | 2300 | 1 |
| 3 | 333 | G.E. | 13800 | 240/480 | 1 |
| 3 | 250 | Al. Ch. | 13,200 | 115/230 | 1 |
| 3 | 250 | Penna. | 24500 | 120/240 | 1 |
| 3 | 167 | G. E. | 12000 | 2400 | 1 |
| 3 | 150 | G.E. | 13200 | 2300/4000Y | 1 |
| 3 | 150 | West | 2300 | 230/115 | 1 |
| 3 | 150 | G.E. | 33000 | 240/480 | 1 |
| 3 | 100 | G.E. | 13200 | 120/240 | 1 |
| 3 | 100 | West. | 4160 | 240/480 | 1 |
| 5 | 50 | G.E. | 240 | 120/240 | 1 |
| 3 | 25 | Atlantic | 2400 | 240/120 | 1 |

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| 40.8 CFM | 3000 3 stage Ingersoll 25 HP Elec |
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| 105 CFM | Worth (gas) portable |
| 142 CFM | 125 psi 6⅞/8x8 Ingersoll Type 40—25 Elec |
| 160 CFM | Worth (gas) portable |
| 198 CFM | 125 psi 9½x9 Worth |
| 211 CFM | 100 psi 9½x9 American 40 HP Elec |
| 254 CFM | 100 psi 10x10 Ingersoll ER-1 40 HP Elec |
| 266 CFM | 500 psi 10/4½x10 Ingersoll 75 HP Synch |
| 276 CFM | 125 psi 2 stage Chicago PB-50 HP Elec |
| 280 CFM | 125 psi 2 stage Gardner "WB" 60 HP |
| 291 CFM | 40 psi 3 cylinder Ingersoll Type 40 |
| 343 CFM | 500 psi 11/5x15 Worth Elec or steam |
| 356 CFM | vacuum 14x5 Ing |
| 364 CFM | 20 psi 12x7 Gardner "RX" 2 available |
| 400 CFM | 125 psi 13/8x10 Ingersoll XRB—Duplex |
| 500 CFM | Worth (Diesel) portable |
| 510 CFM | 125 psi 13/8x12 Ingersoll XRB—Duplex |
| 550 CFM | Vacuum 17x6 Cblo. A |
| 670 CFM | 125 psi 15/9½x12 Ingersoll XRB—Duplex |
| 720 CFM | Vacuum 16x7 Worth HB |
| 931 CFM | 55 psi 17x15 CPT Elec or steam |
| 1035 CFM | 35 psi 20x12 Penn-Sull 100 HP Elec |
| 1184 CFM | Vacuum 22x8 Penn 24Y |
| 1292 CFM | 50 psi 20x15 Chicago T-8 125 HP Elec |
| 1351 CFM | 125 psi 18½-11½x8⅞ Worth YC2 |
| 1574 CFM | 100 psi 22-14x10 Ing PRE2 250 HP 3-60-2300 |
| 1981 CFM | Vacuum 24x13 Chic. TB |
| 1723 CFM | 110 psi "XPV" 4 corner Ing. steam |
| 5790 CFM | 90 psi 30-28x27 Ing PRE 1 700 HP 3-60-2300 |

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## 18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 14" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

*Also*—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

### DIESEL GENERATOR SET

250 KW Cooper Bessemer Model FSN-6, direct coupled to:
General Electric 250 KW, Alternator, 3 phase, 60 cycle, 440 volts, 900 RPM.
Various types and sizes in stock.

ALJON ELECTRIC DIESEL CO.
994 Pacific Street Brooklyn 38, N. Y.
STerling 3-6515

30-40-100 HP Hi-Pressure E. City Boilers
250 HP, 1200 RPM TENV Motor—Rebuilt
75 & 125 HP Locomotive Type Boilers
5 Ton 46'7" Span AC. O.E.T. Crane— Mtrs.
50 & 450 HP Cleaver Brooks Boilers
300 KW Westg 900 RPM Motor Gen. Set
7 & 8 Ton 36" Ga. Gasoline Locomotives
H. & P. 6719 Etzel, St. Louis 14, Mo.

RE-NU-BILT
*GUARANTEED*

## ELECTRIC POWER EQUIPMENT

### D. C. MOTORS

| Qu. | HP | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 1 | 3000 | West. | Tandem | 600 | 600 |
| 1 | 2200 | G.E. | MCF | 600 | 400/500 |
| 1 | 1400 | G.E. | MCF | 600 | 63/190 |
| 1 | 1200 | G.E. | MCF | 600 | 750/950 |
| 1 | 1000 | G.E. | MCF | 600 | 350/550 |
| 1 | 940 | Whse. | QM | 250 | 140/170 |
| 1 | 900 | Whse. | | 250 | 450/550 |
| 1 | 825 | Whse. | | 250 | 95/190 |
| 1 | 600 | Al. Ch. | | 250 | 400/800 |
| 1 | 500 | Whse. | CC-216 | 600 | 300/900 |
| 1 | 500 | G.E. | MCF | 230 | 300/900 |
| 2 | 450 | Whse. | | 550 | 415 |
| 1 | 350 | West. | | 250 | 340/950 |
| 1 | 200 | Whse. | CB-511-3 | 230 | 400/800 |

## A. C. MOTORS—3 Ph. 60 Cy.

### SLIP RING

| Qu. | H.P. | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 1500 | G.E. | MT-498 | 2300 | 360 |
| 1 | 1500 | ABB | | 2300 | 720 |
| 2 | 1000 | A.C. | Mill | 2300 | 240 |
| 1 | 800 | G.E. | MT | 2300 | 293 |
| 1 | 500 | G.E. | MT-412 | 2300 | 580 |
| 1 | 500 | G.E. | M-574Y | 6000 | 900 |
| 1 | 500 | Whse. | CW | 550 | 250 |
| 1 | 400 | Whse. | CW-960A | 440 | 1170 |
| 1 | 400 | Whse. | CW | 440 | 514 |
| 1 | 400 | Whse. | CW-1218 | 2200 | 435 |
| 1 | 350 | G.E. | MT-442 Y | 2200/4000 | 253 |
| 2 | 350 | G.E. | IM-17A | 440/2200 | 720 |
| 1 | 250 | G.E. | MT-424-Y | 4600 | 257 |
| 1 | 250 | G.E. | MT-5595 | 2300 | 1800 |
| 1 | 250 | Al.-Ch. | | 550 | 600 |

### SQUIRREL CAGE

| | | | | | |
|---|---|---|---|---|---|
| 2 | 650 | G.E. | FT-559BY | 440 | 3570 |
| 2 | 450 | Whse. | CS-1420 | 2300/4150 | 354 |
| 1 | 300 | Whse. | CS | 440 | 1170 |
| 1 | 200 | G.E. | IK-17 | 440 | 580 |
| 3 | 200 | G.E. | KT-557 | 440 | 1800 |
| 1 | 150 | Whse. | CS-856S | 440 | 880 |
| 1 | 150 | Whse. | CS | 440 | 580 |
| 1 | 150/75 | G.E. | IK | 440 | 900/450 |
| 2 | 125 | Al. Ch. | ARW | 2200 | 1750 |

### SYNCHRONOUS

| | | | | | |
|---|---|---|---|---|---|
| 1 | 4350 | C.W. | 5561-8L | 13800/6900 | 514 |
| 2 | 2100 | G.E. | ATI | 2300 | 360 |
| 2 | 1750 | G.E. | ATI | 2300 | 3600 |
| 2 | 2000 | Whse. | | 2300 | 126 |
| 2 | 735 | G.E. | ATI | 2300/12000 | 600 |
| 1 | 500 | Ideal | SM | 2300/4160 | 1800 |
| 1 | 500 | Whse. | | 440 | 900 |
| 1 | 450 | Whse. | | 2300 | 128.5 |
| 1 | 450 | Whse. | | 2300 | 450 |
| 1 | 400 | G.E. | TS | 2200 | 600 |

### M-G SETS—3 PH. 60 CY.

| Qu. | K.W. | Make | RPM | DC Volts | AC Volts |
|---|---|---|---|---|---|
| 2 | 2000/2400 | G.E. | 450 | 250/300 | 2300/4600 |
| 1 | 2000 | G.E. | 450 | 600 | 2300/4600 |
| 1 | 2000 | G.E. | 300 25cg | 650 | 11000 |
| 2 | 2000 | G.E. | 514 | 600 | 6600/13200 |
| 1 | 1750/2100 | G.E. | 514 | 250/300 | 4300/2400 |
| 1 | 1500 | G.E. | 720 | 600 | 6600/13200 |
| 1 | 1500 | C.W. | 514 | 30/115 | 4000/13000 |
| 2 | 1000 | G.E. | 720 | 600 | 2300/4600 |
| 1 | 1000 | G.E. | 900 | 260 | 6600 |
| 1 | 750 | C.W. | 514 | 30/115 | 2300 |
| 1 | 750 | G.E. | 900 | 125/250 | 2200 |
| 1 | 600 | G.E. | 720 | 250 | 440/2300 |
| 1 | 500 | Whse. | 1200 | 115/230 | 2300 |

### TRANSFORMERS

| Qu. | KVA | Make | Type | Ph. | Voltages |
|---|---|---|---|---|---|
| 1 | 5000 | Whse. | OISC | 3 | 23000x26400 |
| 1 | 3000 | Wagner | HPW-20 | 3 | 26400x2400 |
| 2 | 4200 | G.E.-Fur. | FOWT | 3 | 13800x200/87 |
| 3 | 2000 | G.E. | HVDDJ | 1 | 66000/13800 |
| 3 | 667 | G.E. | HD | 1 | 13800x2300 |
| 3 | 1000 | G.E. | HVDDJ | 1 | 2400x480 |
| 6 | 1000 | Wagner | OISC | 1 | 13200x460 |

### FREQUENCY CHANGER SETS

| Qu. | KW | Make | Freq. | Voltages |
|---|---|---|---|---|
| 1 | 12500 | Whse. | 60/25 | 13200/13200 |
| 1 | 5000 | G.E. | 60/50/60 | 6600/11000/6600 |
| 2 | 3000 | G.E. | 60/25 | 2300/2300/4000 |
| 3 | 2500 | G.E. | 25/62.5 | 2300/2300 |
| 1 | 1000 | G.E. | 25/58.3 | 4400/2300 |
| 1 | 500 | Al. Ch. | 2560 | 11000/2300 |

## TURBO GENERATORS

| Qu. | KW | Make | Desc. |
|---|---|---|---|
| 1 | 4000 | G.E. | Condensing 423 — 750 P.T.T. Surface Condenser 3/60/2300/4000 V Direct cunn exciter. |
| 1 | 1500 | Whse. | Auto. extraction 190 lbs.—600° P.T.T. 60 lb. extraction 3/60/240 V. Dir. comm. Exc. |
| 1 | 1000 | Moore | Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. |
| 1 | 1000 | G.E. | Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60. |
| 1 | 750 | G.E. | Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944. |

**BELYEA COMPANY, INC.**
43 Howell St., Jersey City 6, N. J.



# CHECK WITH WAGNER FIRST

## "Certified Rebuilt" Motors and Generators

### D. C. MOTORS

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Allis Ch. b.b. | EW | 250 | 1000 |
| 250 | Whse. | SK | 230 | 250/650 |
| 200 | Allis Ch. b.b. | EW | 250 | 850 |
| 150 | Whse. | SK-201 | 230 | 300/900 |
| 150 | Whse. | SK-184 | 230 | 850 |
| 100 | Whse. | SK-175 | 230 | 850 |
| 100 | **Reliance** | 651T | 550 | 1000/1800 |
| 75 | F. Morse b.b. | DH-140 | 115 | 1800 |
| 50 | G.E. dynam.. (4) | TLC25 | 250 | 1000/3500 |
| 50 | Reliance b.b. | 651T | 230 | 750 |
| 50 | Whse. (2) | SK-143 | 230 | 850 |
| 40 | Whse. | SK140 | 230 | 775 |
| 40 | Gen. Elec. | RC32 | 550 | 1200 |
| 30 | Imperial b.b. | D66 | 230 | 400/1600 |
| 30 | Star b.b. (3) | SB | 230 | 1750 |
| 25 | L. A. TEFC | RNA | 230 | 850 |
| 25 | Whse. | SK150 | 230 | 300/1200 |

### MOTOR-GENERATOR SETS

| KW | Mfr. | Input V | Output V |
|---|---|---|---|
| 500 | Whse.* | 2300 AC | 250 DC |
| 300 | Allis Ch. | 2200/440 AC | 125/250 DC |
| 250 | Allis Ch. | 2200/440 AC | 250 DC |
| 200 | Cr. Wheeler* | 2300/4150 AC | 250 DC |
| 200 | Whse.* | 220/440 AC | 85 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 150 | Whse. | 2200/440 AC | 275 DC |
| 125 | **Gen. Elec.*** | 2300/4000 AC | 250 DC |
| 105 | Century b.b. | 220/440 AC | 70 DC |
| 100 | G.E.* | 2200/440 AC | 125 DC |
| 100 | Whse. | 220/440 AC | 250 DC |
| 75 | F. Morse b.b. | 220/440 AC | 125/250 DC |
| 75 | Cont. b.b. | 220/440 AC | 125 DC |
| 60 | Gen. Elec.* | 220/440 AC | 60 DC |
| 60 | Whse (2) | 220/440 AC | 300 DC |
| 50 | Gen. Elec. | 220/440 AC | 125 DC |
| 50 | Whse. | 220/440 AC | 250 DC |
| 40 | Gen. Elec. | 220/440 AC | 600 DC |
| 30 | Gen. Elec. | 220/440 AC | 250 DC |
| 30 | Gen. Elec. (2) | 220/440 AC | 125 DC |
| 30 | F. Morse b.b. | 220/440 AC | 24 DC |
| 25 | Whse. | 220/440 AC | 125 DC |

### D. C. GENERATORS

| KW | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Al. Ch. | AECW | 125/250 | 1200 |
| 250 | Allis Ch. b.b. | EW | 250 | 1200 |
| 175 | Allis Ch. b.b. | EW | 250 | 900 |
| 150 | Gen. Elec. b.b. | CDM | 250 | 1500 |
| 135 | Whse. | SK-184 | 250 | 1150 |
| 105 | Century b.b. | 1500 amp. | 70 | 1200 |
| 100 | Whse. | SK-172 | 250 | 1150 |
| 100 | Whse. | SK163 | 250 | 1500 |
| 100 | Allis Ch. | E | 125 | 1200 |
| 100 | **Reliance** | 651T | 600 | 1200 |
| 75 | Cont. b.b. | D109X | 125 | 1150 |
| 75 | F.M. b.b. | DH | 125 | 1800 |
| 75 | G.E. b.b. (2) | CDM135 | 125 | 750 |
| 60 | Whse. b.b. (2) | SK121 | 300 | 1200 |
| 50 | Whse. (2) | SK-143 | 250 | 1150 |
| 40 | Whse. | SK140 | 250 | 1100 |
| 40 | Gen. Elec. | RC32 | 600 | 1750 |
| 25 | Whse. | SK93 | 125 | 1750 |
| 25 | C.W. b.b. (2) | CCD | 250 | 1200 |

### A. C. MOTORS — 60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 750 | G.E. | Synch. | 2200 | 514 |
| 700 | Allis Ch. | Sq. Cage | 440 | 900 |
| 650 | Allis Ch. | Slipring | 2300 | 900 |
| 600 | Gen. Elec. | Sq. Cage | 2200 | 3600 |
| 500 | G.E. | Sq. Cage | 4000 | 1800 |
| 500 | G.E. | Slipring | 2200/440 | 450 |
| 500 | G.E. | Synch. | 440 | 900 |
| 450 | Allis Ch. | Synch. | 450 | 600 |
| 400 | Whse. | Sq. Cage | 2300 | 514 |
| 400 | G.E. | Synch. | 440 | 450 |
| 350 | Whse. (2) | Slipring | 2300 | 450 |
| 300 | G.E. (2) | Slipring | 2200/440 | 720 |
| 300 | El. Machy | Synch. | 220/440 | 360 |
| 300 | Al. Ch. | Sq. Cage | 2200/440 | 720 |
| 300 | Whse. | Synch. | 2200/440 | 600 |
| 300 | G.E. | Slipring | 440 | 360 |
| 250 | Gen. Elec. | Synch. | 220/440 | 450 |
| 250 | G.E. | Synch. | 220/440 | 720 |
| 250 | Whse. (3) | Sq. Cage | 2300/440 | 1200 |
| 250 | L.A. (2) | Sq. Cage | 2300 | 1800 |
| 225 | G.E. | Synch. | 220/440 | 900 |
| 200 | Gen. Elec. | Sq. Cage | 220/440 | 1200 |
| 200 | Reliance b.b. | Sq. Cage | 220/440 | 1800 |
| 200 | Allis Ch. | Slipring | 440 | 450 |
| 200 | Gen. Elec. | Sq. Cage | 2300/440 | 720 |
| 200 | Cr. Wh. | Sq. Cage | 220/440 | 3600 |
| 200 | Whse. | Sq. Cage | 2300/440 | 900 |
| 200 | E. M. | Synch. | 220/440 | 1200 |
| 200 | E. M. | Synch. | 220/440 | 514 |
| 175 | G.E. (2) | Synch. | 220/440 | 720 |
| 175 | Whse. | Synch. | 2300/440 | 900 |
| 150 | El. Machy. | Synch. | 220/440 | 360 |
| 150 | Whse. | Sq. Cage | 220/440 | 900 |
| 150 | G.E. | Synch. | 220/440 | 450 |
| 150 | Allis Ch. | Slipring | 2300/440 | 720 |
| 150 | G.E. (2) | Sq. Cage | 2300/440 | 720 |
| 150 | Allis Ch. | Sq. Cage | 2300/440 | 1200 |
| 150 | Rel. b.b. | Sq. Cage | 220/440 | 1800 |
| 150 | Allis Ch. | Sq. Cage | 440 | 450 |
| 150 | G.E. vertical | Slipring | 4000/2300 | 1200 |
| 125 | G.E. TEFC | Sq. Cage | 220/440 | 3600 |
| 125 | Whse. | Sq. Cage | 220/440 | 900 |
| 125 | Rel. TEFC | Sq. Cage | 220/440 | 1800 |
| 125 | G.E. | Slipring | 220/440 | 450 |
| 125 | E. M. | Synch. | 220/440 | 1800 |
| 125 | Allis Ch. | Slipring | 220/440 | 900 |
| 100 | G.E. | Slipring | 220/440 | 514 |
| 100 | G.E. | Slipring | 220/440 | 900 |

### A. C. GENERATORS — 60 CYCLE

| KVA | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 1000 | Whse. syn cond | | 4000/2300 | 900 |
| 625 | Gen. Elec. | ATB | 2300 | 450 |
| 600 | Gen. Elec. | ATB | 480 | 900 |
| 485 | Allis Ch. | 1 brg. | 480 | 600 |
| 312 | Gen. Elec. | ATB | 240/480 | 600 |
| 275 | G.E. 25 cycle | ATI | 480 | 750 |
| 225 | El. Machy. | | 480 | 720 |
| 225 | Gen. Elec. | ATI | 240/480 | 900 |
| 150 | Gen. Elec. | ATB | 2300 | 900 |
| 150 | Whse. | | 2300/480 | 600 |
| 125 | Gen. Elec. (2) | ATB | 240/480 | 900 |
| 75 | El. Machy. | | 2300 | 900 |
| 50 | G. E. | ATB | 240/480 | 1200 |

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# BREW WOLTMAN *Offers—*

3500 KW 80% PF West. Cond. Turbo Gen., 3-60-2400/4160 V., 3600 RPM 400 PSIG, 750° TT, dir. con. exciter, surf. cond. New 1948.

3000 KW 80% PF G.E. Cond. Turbo Gen. 3-60-2400/4160 V., 3600 RPM, 385 PSIG, 750° TT, dir. con. exciter, surf. cond.

4000 KW 80% PF G.E. Non-Cond., auto extr. Turbo Gen. 3-60-13800 V., 3600 RPM 600 PSIG 750° TT, 135# extr., 50# max. BP. NEW.

*Full line power equipment—send us your inquiries.*

**BREW, WOLTMAN & CO., INC., 50 Church St., New York 7**

# GET FULL VALUE FOR EVERY EQUIPMENT DOLLAR

## with CHICAGO ELECTRIC GUARANTEED "REBUILTS"

WIRE
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OR PHONE
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6-2900

### TRANSFORMERS
(Single Phase)

| Q | KVA | Make | Type | Volts |
|---|---|---|---|---|
| 1 | 667 | G.E. | Oil | 13800-480 |
| 2 | 333 | Al-Ch. | Oil | 12300-2400 |
| 3 | 250 | Westg. | Oil | 2400/4160-480/240 |
| 1 | 200 | Wagner | Oil | 2400/4160-575 |
| 3 | 150 | Chgo Elec. | Air | 2300-110/220 |
| 3 | 100 | Al.-Ch. | Oil | 2400-240/480 |
| 3 | 100 | Jeff. | Air | 2400-220/110 |
| 2 | 100 | Maloney | Oil | 2300-220/110 |
| 2 | 100 | G.E. | Oil | 2300-115 |
| 1 | 100 | G.E. | Oil | 2400-120/240 |
| 2 | 100 | Pitts. | Oil | 2400-575 |
| 1 | 100 | Pitts. | Oil | 2400-120/240 |
| 2 | 75 | G.E. | Oil | 2400-120/208 |
| 2 | 50 | Westg. | Oil | T200/12470-120/240 |
| 2 | 50 | Westg. | Oil | 2300/2150-115 |
| 1 | 50 | Gregory | Oil | T200/12470-240/480 |
| 1 | 50 | G.E. | Oil | 2300-115 |

### SYNCHRONOUS MOTORS
3 phase, 60 cycle, 220 or 440 volt
(*2300 volts or higher)

| HP | Make | Type | Power Factor | Speed |
|---|---|---|---|---|
| 1420 | *Westg. | | .7 | 900 |
| 720 | *Westg. | | 1.0 | 900 |
| 710 | *G.E. | ATI | 1.0 | 720 |
| 600 | *G.E. | TS-7649 | 1.0 | 300 |
| 500 | *G.E. | TS-7657 | 1.0 | 514 |
| 400 | *Westg. | H | .8 | 1800 |
| 400 | West. | HG | 1.0 | 900 |
| 300 | G.E. | ATI | .8 | 720 |
| 300 | *Ideal | SMM | .8 | 257 |
| 300 | G.E. | ATI | .8 | 1200 |
| 250 | G.E. | ATI | .8 | 900 |
| 250 | G.E. (New) | TS-974Y | .8 (2 brg) | 720 |
| 225 | G.E. | TS-6244 | 1.0 | 300 |
| 225 | El. Mch. | | 1.0 | 300 |
| 200 | F. Morse | TJC-285 | .8 | 720 |
| 190 | El. Mch. | | 1.0 | 720 |
| 150 | F. Morse | TJC-285 | .8 | 720 |
| 150 | G.E. | ATI | .8 | 720 |
| 150 | *El. Mch. | | .8 | 1200 |
| 150 | Westg. | HR | 1.0 | 300 |
| 125 | *G.E. | TS-7641 | 1.0 | 514 |
| 125 | *G.E. | TS-8214 | 1.0 | 277 |
| 125 | *El. Mch. | | 1.0 | 900 |
| 115 | El. Mch. | | 1.0 | 240 |
| 110 | G.E. | TS | .9 | 514 |
| 100 | West. | | 1.0 | 900 |
| 100 | Ideal | SNE | 1.0 | 900 |
| 15 | Ideal | FRS | 1.0 | 1800 |
| 15 | Century | AHV-345 | 1.0 | 1200 |
| 7½ | Ideal | FRS | .8 | 1800 |

### SLIP RING MOTORS
3 phase, 60 cycle, 220 or 440 volts
(*2300 volts or higher)

| HP | Make | Type | Speed |
|---|---|---|---|
| 2000 | *G.E. | MT | 600 |
| 1500 | *G.E. | MT-30 | 240 |
| 1000 | *Westg. | CW | 450 |
| 700 | *Al-Ch. | ANY | 720 |
| 500 | G.E. | I-17A | 900 |
| 500 | Westg. | CW | 250 |
| 400 | *G.E. | MT-412 | 450 |
| 300 | *G.E. | IE-15A | 1800 |
| 300 | *G.E. | MT-568 | 720 |
| 250 | Westg. | HP-15H | 600 |
| 250 | *G.E. | I-17B | 450 |
| 200 | G.E. | IK-15B | 900 |
| 200 | G.E. | IM-17 | 600 |
| 150 | G.E. | MT-549 | 1800 |
| 150 | *Al-Ch. | ANY-30F1 | 1200 |
| 150 | Westg. | CW-868A | 720 |
| 150 | Westg. | CW | 450 |
| 125 | G.E. | IM-15A | 600 |
| 100 | G.E. | MT-556 | 900 |
| 100 | G.E. | MT-558 | 720 |
| 100 | G.E. | IM | 600 |
| 75 | G.E. | MT-347 | 1200 |
| 75 | G.E. | MT-356 | 900 |
| 75 | G.E. | MT-556 | 720 |
| 75 | G.E. | IM | 600 |
| 60 | *Westg. | CW-762C | 900 |
| 50 | Westg. | CW-636A | 1200 |
| 50 | G.E. | MT-336 | 900 |
| 50 | G.E. | MT-346 | 720 |
| 50 | G.E. | IM | 450 |

### D. C. MOTORS — 230 Volt

| HP | Make | Type | Speed |
|---|---|---|---|
| 250 | Westg. | SK-229 | 450/600 |
| 200 | Westg. | SK-261 | 650 |
| 200 | Cr. Wh | CM | 500 |
| 175 | G.E. | KLC | 750 |
| 100 | G.E. | MPC | 460/800 |
| 100 | G.E. | HC-34 | 2500 |
| 100 | G.E. | HC-10 | 875 |
| 100/150 | G.E. | MCP | 380/1000 |
| 75 | G.E. | BCP-34 | 1750 |
| 75/25 | Westg. | SK-151 | 400/1600 |

### SLIP RING MOTORS
Crane and Hoist Service
3 phase, 60 cycle, 220 or 440 volt

| HP | Make | Type | Speed |
|---|---|---|---|
| 80 | G.E. | MTC-5552 | 600 |
| 75 | Westg. | CI-756A | 600 |
| 50 | Westg. | MW-234 | 600 |
| 50 | G.E. | HIC TENV | 600 |
| 35 | G.E. | MTC-5536 | 600 |
| 20 | Westg. | CI | 1200 |

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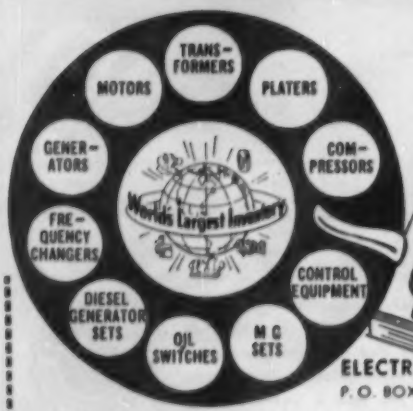


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**MAY SPECIAL**— F.O.B. Detroit • **4—1500 KW Motor Generator Sets**
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## DIESEL GENERATOR SETS

3—1600 HP Fairbanks Morse Model OP 720 RPM, 1420 KVA FM 3/60/2400 volt generators. New 1949.

1—750 HP Superior 8 cylinder, 400 RPM, 500 KW Elec. Mchy. 3/60/2400 volt generator & auxiliaries.

1—400 HP Superior 4 cyl. 400 RPM Model VDSE, 250 KW, 3/60/2400 volt.

**MISSISSIPPI VALLEY EQUIPMENT CO.**
507 Locust St., St. Louis 1, Mo.

130 HP 600 RPM Superior Diesel Engine
75 HP C.W. Slip-ring Motor 1160 RPM with Automatic Reduced Voltage Starter.
Universal Uniflow Skinner Steam Engine 100 HP.

**JOHN F. CARSON**
A & Venango Sts. Philadelphia 34, Pa.
GArfield 6-2221

## MOTORS · MG SETS

*All guaranteed for one year*

| Qty. | HP | Make | Voltage | Speed |
|---|---|---|---|---|
| 12 | 2000 | West. | 325/600 | 600 RPM |
| 26 | 1500 | West. | 625/600 | 600 RPM |
| 38 | 1500 | Al. Ch. | 625/600 | 675 RPM |
| 4 | 1200 | Al. Ch. | 625/600 | 650 RPM |
| 2 | 900 | Elliott | 220 | 300/750 RPM |
| 3 | 800 | West. | 625/600 | 600/900 RPM |
| 1 | 600 | Cr. Wh. | 220 | 475/720 RPM |
| 1 | 500 | West. | 220 | 250/500 RPM |
| 1 | 450 | West. | 220 | 600/1200 RPM |
| 1 | 400 | G.E. | 220 | 460/360 RPM |
| 7 | 400 | Elliott (new) | 220 | 600/900 RPM |
| 8 | 400 | West. (new) | 220 | 375/750 RPM |
| 2 | 350 | Cr. Wh. | 220 | 600/900 RPM |
| 1 | 200 | Cr. Wh. | 220 | 900/753 RPM |
| 1 | 300 | Cr. Wh. | 220 | 375/750 RPM |

All motors designed for mill reversing service. Smaller sizes also in stock.
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All of above is modern late type equipment remanufactured & tested by our engineers.
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GENERATOR: 12-KW, 15 KVA, 1 phase, 110-200 Volt AC, 1200 RPM. Set 10362

ENGINE: Caterpillar, YCYL Diesel, Mod. 203420

TRL: Tilt Bed Type—Steel Van rear dr. 4 sing. wheel 7 50/20

TRL MOUNTED GENERATOR

Generator 35 KVA, 125 Volts, 60 cycle, 3 phase, Hobart

ENGINE: WXLC-3 Hercules—Trailer Tilt Bed—Wt. 3668 lbs.

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1—G.E. 5000 KVA, 6900/2300v., 3 ph., 60 cy., type HT—Form DA, 2½% Taps, above and below normal, impedence 5.32% at 6900v.

4—Al. Chal. 667 KVA, 2300/460v., 1 ph., 60 cy., Type DSC, 4—2½% Taps below normal—45% impedence.

**FS-6247, POWER**

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**AC TO AC MOTOR-GENERATOR SET**

Gen'l. Elec., 25 KW, 3 phase, 60 cycle, 440 volt, Type ATI coupled to 40 HP, 1800 RPM, 440 volt, Type TS, Synchronous Motor with direct connected exciter, Ball Bearing, 2 unit, 4 bearing factory built set. Slightly Used.

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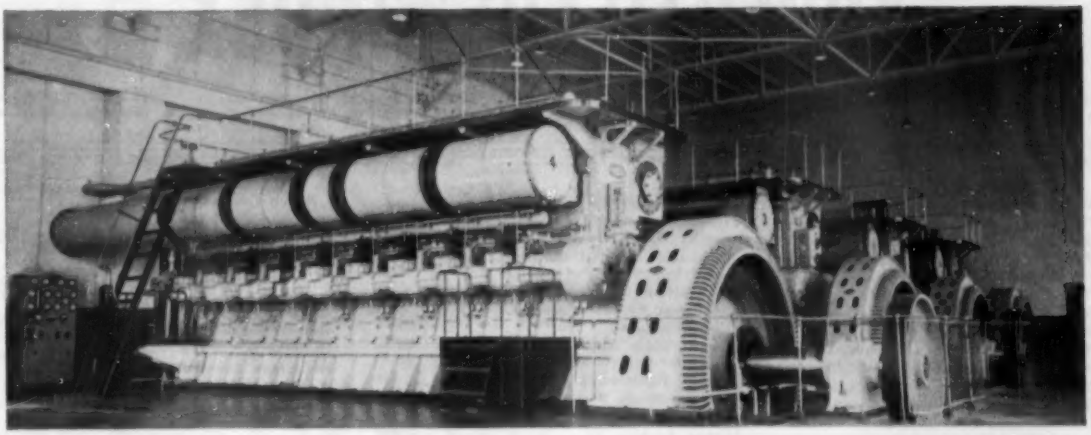
## FOR SALE – Complete or As INDIVIDUAL UNITS



THREE (3) BUSCH-SULZER (NORDBERG) DIESEL ENGINES, 3060 HP, 9 cylinder, 2 cycle, 240 RPM, Type 9 DHB-27, direct coupled to: THREE (3) 2700 KVA, E. M. C. ALTERNATORS, 3/60/2300/4160 V.

*Each Unit Complete with all Auxiliaries. NEW 1943—Can be inspected operating.*

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***Reconditioned by U.S. Navy***

**EQUAL TO NEW**

Complete with motor driven starting air compressors, air tanks, dead front type generator switch panels and all other necessary accessories.

**ENGINES**

G.M. Model 8-268A—8½X7—1200 RPM—air starting—complete with engine operating panels, heat exchangers, cooling pumps, filters, strainers, governors, pyrometers, etc.

**GENERATORS**

Westinghouse 200 KW 250 KVA—440/3/60—1200 RPM—80% P.F.—continuous—drip-proof enclosure—direct connected exciter.

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Each unit, mounted on a pre-fab sub-base, is 12' 0 5/16" long, 5' 10½" wide, approx. 9' high. Weight of engine and generator only, 17,705 lbs. Each unit, with all accessories, about 27,000 lbs.

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BALTIMORE 2, MD CURTIS 7-5050

# *Rebuilt* HEMPHILL *Guaranteed* EQUIPMENT

**TRANSFORMERS 60 CYCLE**

| Qu | KVA | Make | Type | PH. | Voltages |
|---|---|---|---|---|---|
| 2 | 3750 | G.E. New | OISC | 3 | 26400x4160 |
| 1 | 1000 | G.E. | Auto | 3 | 4150x3400 |
| 1 | 1000 | Amer. | OISC | 3 | 4150x480 |
| 1 | 750 | G.E. | HT | 3 | 4150x120/240 |
| 2 | 750 | G.E. | H | 1 | 4000x120/240 |
| 1 | 500 | Kuhl | OISC | 1 | 4000x2300 |
| 2 | 400 | Pitts. | OISC | 1 | 4150x240/480 |
| 1 | 333 | G.E. | H | 1 | 13200x230/440 |
| 3 | 300 | G.E. | H | 1 | 13200x440 |
| 1 | 200 | G.E. | HT | 3 | 2400x240 |
| 1 | 200 | G.E. | H | 3 | 4150x2400Y |

**SYNCHRONOUS MOTORS**

| QU | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 500 | Whse. | 450 | HR | 2300 |
| 1 | 400 | Whse. | 450 | HR | 2300 |
| 1 | 350 | Whse. | 450 | HR | 440 |
| 1 | 300 | Elec | 720 | TEFC | 2300 |
| 1 | 300 | G.E. | 600 | ATI | 440 |
| 1 | 200 | Whse. | 600 | ATI | 440 |
| 1 | 175 | G.E. | 720 | ATI | 2300 |
| 3 | 150 | G.E. | 1200 | TS | 4160 |
| 1 | 150 | G.E. | 1000 | TS | 2300 |
| 1 | 150 | Whse. | 900 | IHIC | 220 |
| 2 | 150 | Allis | 360 | | 2300 |
| 1 | 135 | EM | 900 | | 4800 |
| 1 | 100 | G.E. | 900 | TS | 2300 |

**SLIP RING MOTORS**

| QU | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 500 | G.E. | 1900 | M | 2400/4160 |
| 1 | 400 | Whse. | 450 | CW | 550 |
| 1 | 250 | Whse. | 60 | CW | 440 |
| 2 | 200 | Whse. | 600 | CW | 440 |
| 1 | 200 | G.E. | 600 | MT | 440 |
| 1 | 150 | A.C. | 1800 | AY RW | 2300 |
| 1 | 100 | G.E. | 1800 | IM | 220 |
| 1 | 100 | G.E. | 600 | IM | 440 |
| 1 | 75 | G.E. | 600 | IM | 440 |
| 3 | 60 | G.E. | 1800 | MT | 220 |

**MOTOR GENERATOR SETS**

| Qu | KW | Make | Speed | DC | AC |
|---|---|---|---|---|---|
| 1 | 1000 | G.E. | 514 | 600 | 2300/4150 3yn |
| 1 | 1000 | Whse. | 720 | 600 | 2300/4150 3yn |
| 1 | 1000 | Whse. | 720 | 275 | 2300/4150 3yn |
| 1 | 500 | G.E. | 1200 | 250 | 2300/4150 3R |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4150 3yn |
| 1 | 200 | Whse. | 900 | 250 | 2300/4150 3yn |
| 1 | 150 | C.W. | 600 | 125 | 220/440 V |
| 1 | 100 | G.E. | 900 | 250 | 2300 3yn |
| 3 | 97 | G.E. | 1200 | 60 | 4150 3yn |
| 1 | 75 | G.E. | 1800 | 250 | 220/440 3C |
| 1 | 60 | Whse. | 1200 | 60 | 2300 V |
| 3 | 60 | EM | 1200 | 125 | 230 |
| 1 | 30 | Whse. | 900 | 250 | 440 |
| 2 | 30 | G.E. | 1750 | 240 | 220/440 |
| 1 | 25 | G.E. | 1800 | 250 | 230 V 3yn |
| 1 | 20 | EM | 1800 | 125 | 230 V |
| 1 | 7½ | Allis | 1800 | 125 | 220/440 |
| 2 | 1½ | G.E. | 1800 | 125 | 220/440 |
| 3 | 1¼ | G.E. | 2666 | 500 cy<br>1 ph | 220/440 |
| 2 | 3 | G.E. | 1800 | 250 | 220/440 |

**DC, 230 VOLT MOTORS**

| Qu | HP | Make | Speed | Type |
|---|---|---|---|---|
| 1 | 300 | G.E. | 1450 | MFO |
| 2 | 150 | C.W. | 900 | WP |
| 1 | 125 | G.E. | 1760 | BD |
| 2 | 75 | C.W. | 900 | WP |
| 1 | 30 | C.W. | 700 | CM |
| 1 | 25 | G.E. | 850 | BC |
| 1 | 20 | Whse. | 835 | BK |

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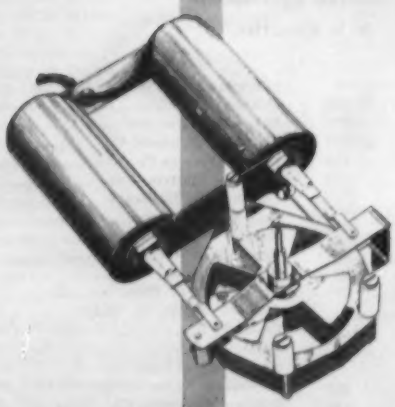
## *for recording pH or conductivity*

# offers this cost-saving combination



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**2. Freedom from slidewire limitations**

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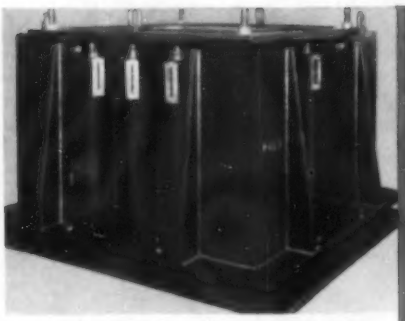
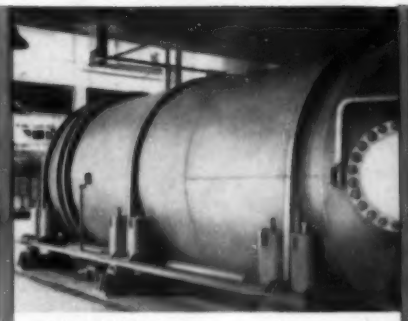
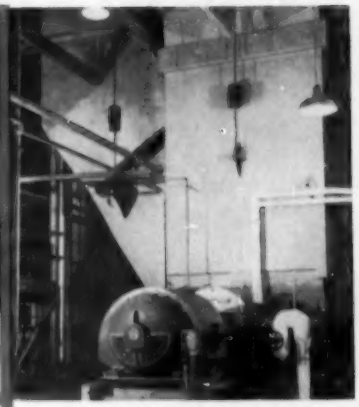


Base for supporting refinery tower, provided with Grinnell Spring Hangers for flexible support.



Grinnell Spring Hangers on large vessel of catalytic cracking unit in oil refinery.



Induced draft duct and blower in power station. Operates at about 500°F. Supported by Grinnell Spring Hangers.

## To support loads that won't stand still . . .

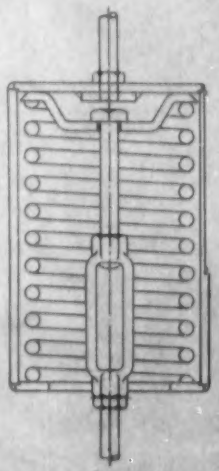
# GRINNELL PRE-ENGINEERED SPRING HANGERS

There are many industrial installations where heavy loads must be firmly, but flexibly, supported to keep them under control. Thermal expansion and contraction, of course, can move ponderous objects many inches. Shock and vibration, too, can make rigid support of heavy loads hazardous, due to possible serious trouble at terminals.

For installations such as these, more and more engineers are turning to *flexible* supports by Grinnell. Grinnell Variable Spring Hangers are *pre-engineered* to minimize changes in supporting force over total range of movement. Here are the important features that let these units turn in a star performance in a supporting role:

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- Solid steel casing protects spring from damage and weather. Guides assure continuous alignment and concentric loading of spring.
- 18 sizes available from stock — load ranges from 53 lbs. to 12,000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.

*Precompression is a patented feature.*



**VARIABLE SPRING HANGER FIG. B-268**

Fig. B-268, Type A, is designed for attachment to its supporting member by screwing a rod into a bushing in the top cap of the hanger. Adjustment of the hanger load is accomplished by turning the turnbuckle on the lower hanger rod until the hanger picks up the load and the load indicator points to the desired position. Six other types of attachment are available.

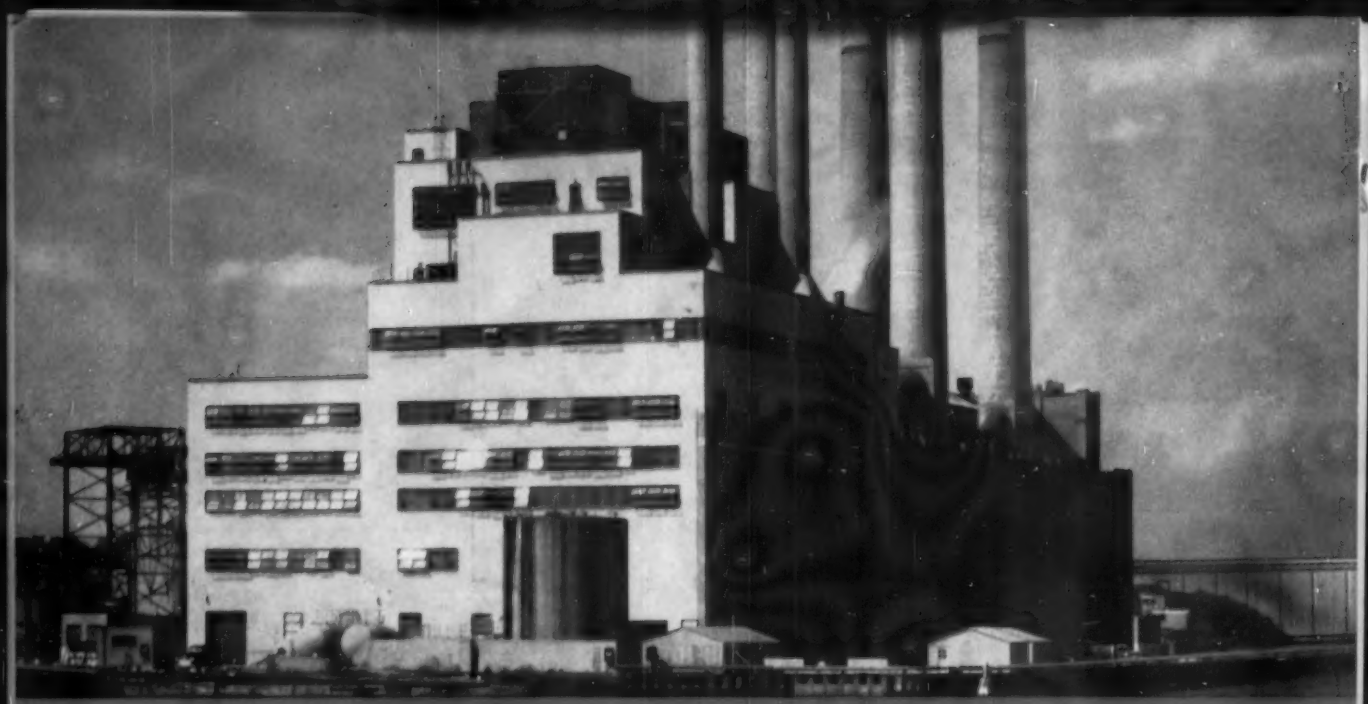
Grinnell Variable Spring Hangers are also available in half sizes (Fig. B-82); and in double spring sizes (Fig. B-98).

# GRINNELL

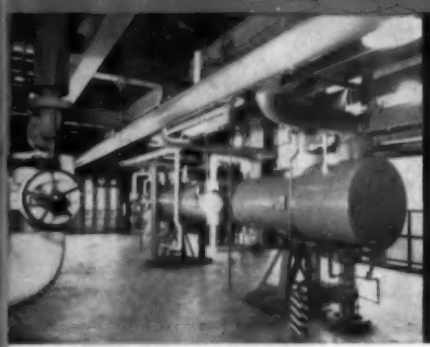
**AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS**

**Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors**

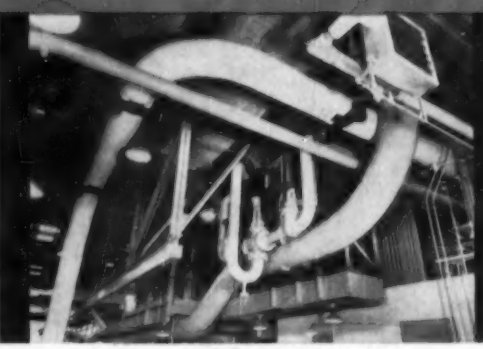
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



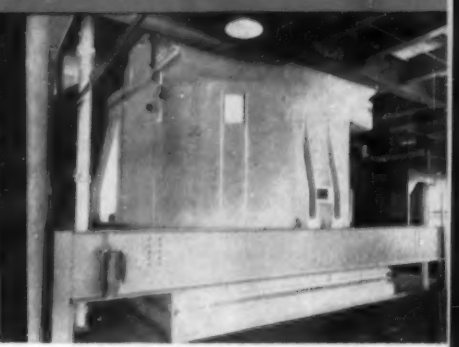
# UI puts the Harness on Heat!



1st low pressure feedwater heater—17th stage, in one of the two recent additions to U. I.'s plant (new buildings shown in foreground of large photo above).



Main steam pipes carrying steam from boiler to turbine at 850 lbs., 900 degrees F. All are covered with Carey Insulation.



Gas enters this Air Heater at 650 degrees F., leaves at 300 degrees F. Air enters at room temperature, leaves at about 600 degrees F. The heater is Carey-insulated.

## Carey Insulation

### Reduces fuel bills at 165,000 K.W. United Illuminating Power Plant

This big United Illuminating Company power plant at New Haven, Conn. burns a thousand tons of fuel every 24 hours. In dollars, that represents millions every year! So it's vitally important to keep every last BTU on the job producing power. Wasted BTUs are wasted dollars!

U. I. assigned Carey Tempchek and Carey Super-Light 85% Magnesia to the task of conserving heat energy. This combination features extremely low thermal conductivity, unusual resistance to moisture and vibration, lightweight, maximum efficiency from 200° F. to 1900° F. And both of these fine Carey insulations are easily worked to fit irregular shapes.

Whatever *your* problem in heat conservation, Carey products and services will help you solve it. The Carey line includes pre-formed blocks, nesting "O.D." pipe coverings, blankets, pipe wrapping and jackets, cements. All are clean to handle, easy and economical to apply. Ask your Carey Industrial Sales Engineer to consult with you about them soon.

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